THE

South Eastern Naturalist.

THE TRANSACTIONS

OF THE

Associated Natural History Societies

OF THE

SOUTH EAST OF ENGLAND.

PAPERS AND NOTES

BY THE MEMBERS OF THE

East Kent Natural History Society, and of the Dover Natural History and Antiquarian Society.

Canterbury:

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PREFACE.

Though Members of Local Natural History Societies are carrying on valuable original work much of their labour is lost because their Society is not able to issue transactions, either from want of funds or from lack of sufficient material.

In order to give method and definiteness to original investigations, and to ensure more complete records, a scheme of association has been formulated by the committees of the East Kent Natural History Society and the Dover Field Club.

This scheme is wide enough to embrace all Natural History or Scientific Societies in the South Eastern Counties, and yet it is so formed as not to interfere with the constitution and government of any individual Society. The advantages to be expected from co-operation are mainly three :—First, combined systematic investigation ; second, the recording and publication of results in such a manner as to ensure that they shall become generally known through the communication of them to the committee of the corresponding Societies of the British Association ; and third, the advantage of being represented by a delegate on that committee.

For the transactions of the associated Societies the title "South Eastern Naturalist" has been adopted as sufficiently wide to admit communications from all, and yet sufficiently limited to define the district in which the investigations recorded have been made.

At present the only Societies in the Association are the East Kent Natural History Society and the Dover Field Club, but it is hoped that others will join.

The transactions hitherto issued periodically by the East Kent Natural History Society, will, for the future, be issued in the "South Eastern Naturalist."

W. P. MANN, } *Joint Secretaries to the*
S. WEBB, } *Publishing Committee.*

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TRANSACTIONS.

I.

REPORT ON TEMPERATURE OF THE RIVER STOUR, AT CANTERBURY,

BY

A SUB-COMMITTEE OF THE EAST KENT NATURAL HISTORY SOCIETY, APPOINTED FOR THE PURPOSE.

DECEMBER 13, 1888, to DECEMBER 31, 1889.

With the view of giving effect to the intentions of the Committee of the British Association appointed to arrange an investigation of the seasonal variations of temperature in lakes, rivers, &c., in various parts of the United Kingdom, in conjunction with the Societies sending delegates to the the above Association, the Committee of the East Kent Natural History Society, wrote for and procured a copy of "Directions to Observers," together with a Thermometer and Observation Book, from John Gunn, Esq., F.R.S., G.S., Edinburgh, and appointed a Sub-Committee to carry out the instructions contained in the Secretary's letter of November, 1888. They were fortunate in securing the willing services of an associate of their Society, Mr. Henry Dean, of 35, St. Peter's Street, Canterbury, by whom the observations now to be reported on were made.

The observations commenced on the 13th December, 1888, and have been continued day by day throughout the year, 1889.

The river in which the observations are taken forms the western branch of the river Stour, which flows through Canterbury and empties itself into the sea at Pegwell Bay, near Sandwich, about 15 miles distant. The depth of water is about two feet in the ordinary state of the river, increasing to three feet or more when the river is in flood. The direction of the stream is from S.W. to N.E. The banks are low and shaded with trees.

In accordance with the directions received from the Secretary of the Committee, the observations were taken at 9 a.m. regularly day by day, always at the same place, and within five minutes walk from Mr. H. Dean's house. Remarks on "State of River and Weather," are entered in the Observing Book at the same time. The following are some of the results noted:—

In December, as a general rule, the temperature of the water is higher than that of the air, but there are exceptions, e.g., on the 19th

December, 1888, the temperature of air and water was nearly the same, viz: 43°, the wind at the time was W.S.W., and the weather clear and fine. It was the same on the 24th December. The greatest difference in the temperature of air and water was on the 25th, (Xmas Day) when that of the air was 35°, and of the water 44°.3.

On the 1st January, 1889, the difference is more remarkable, viz: air 30°.6, water 40°, and the same was the case on the day following, viz: air 29°, water 38°.5, with the wind N.E., and weather fine.

A sudden rise of temperature occurred on the 8th January, when that of the air was 39°.8, and of the water 38°.2, somewhat colder than the air, the wind south, and the weather fine. The same was the case the day following, viz: air 45°, water 41°.5.

As a rule, the temperature of the water does not increase so rapidly as that of the air. On the 5th May for instance, the air was 69°, and the water 57°.2; the same on May 9th, viz: air 62°, water 57°.

In February, with snow on the ground, the temperature of the air varied from 25°.8, to 34°.8, and that of the water from 34°.6, to 39°.5, the wind at the time being E. to N.E. Speaking generally, it is observed that with the wind S. or S.W., and rain falling, the temperature of air and water differ only one or two degrees.

The above remarks refer to observations taken up to 15th May, 1889. In the same month the temperature of the air rose considerably, the highest being on the 29th, when it was 69°.8, while that of water was only 60°, the wind being S.W., and weather fine.

Towards the end of May the temperature of air and water once more approximated. On the 2nd June there was a sudden and considerable rise in the air temperature, but only a moderate rise in that of water, the difference between them being 14°, with the wind as above, this again shewing that the water temperature rises slower than that of the air.

On the 10th June, with a N.N.E. gale blowing, the temperature of the air fell to 53°, while that of the water was 55°.2. As a general rule the water temperature was below that of the air throughout this month. The last-mentioned is, in fact, the only instance to the contrary.

On the 20th June the thermometer in use was accidentally broken, and it was not until the 19th September that a new one of similar construction arrived from Edinburgh. Meanwhile an ordinary instrument was supplied to Mr. Dean, and with it the observations were taken, recorded in the above interval.

The readings of this instrument, and that subsequently supplied from Edinburgh, were found to agree very fairly, and the results of the observations taken during the interval, shew, as might have been expected, that the air temperature is above that of water throughout the summer months, June, July, and August, with one single exception, viz: on the 23rd August, when the air was one degree colder than the water, with the wind N.W., and weather fine.

A similar exception to the general rule occurred on the 16th September, the air being 53°, and the water 55°, with the wind also in the N.W. Again on the 17th, with the wind S.E., and weather fine, the air was one degree colder than the water.

From the 20th September to the end of December the new thermometer was in use, and it is observable that from that date to the 7th October the temperature of air and water approximated very nearly, the water, as a rule, being the colder of the two. From the 9th October, however, there are several exceptions to this rule, notably on the 13th and 14th, when the water temperature was 4° higher than that of the air, the latter having fallen some 6° in two days, and the water only 2° during the same interval. The same was the case on the 25th October, with the wind N N.W., and the weather fine. In November and December the fluctuations in the relative temperatures of air and water were frequent, but, speaking generally, the water temperature was higher than that of the air, the greatest difference between them being on the 29th December, on which date the air registered 26°.5, and the water 40° 3, a difference of 13°.8. This is the coldest day recorded, with the wind S.W., and weather fine.

In conclusion, it should be mentioned that the prevailing direction of the wind in Canterbury and neighbourhood for the greater part of the year is from the S.W., veering to W., and N.W. In the spring of the year it is from the E., veering to E.N.E. and N.E. At such period the temperature of the air is invariably colder than that of the water, the atmosphere very dry, and plenty of dust flying about, much to the satisfaction of the farmers, being, in fact, the origin of the saying in Kent, "A peck of March dust is worth a king's ransom." At other seasons of the year when the wind is from the S. and S.W., the reverse is the case, i.e., the water is the colder of the two. The highest air temperature recorded in these observations was on the 7th June, viz: 74°, while the water temperature on the same date was 62°.

W. H. Horsley, Col.

II.

NOTES ON THE GROWTH OF A PLANT OF THE GIANT HOGWEED (HERACLEUM GIGANTEUM) FROM A SEEDLING TO MATURITY,

BY

Mr. J. REID, F.R.C.S., Eng.

Read October 11, 1888.

The specimen observed was a Seedling taken from the ground outside the St. Augustine's Gaol, Canterbury, where the plant, in its successive generations, had been established for more than 20 years. It

was transplanted in the spring of 1885, and it had, probably, germinated in the previous year, as it had not the earliest form of growth; for it should be noted that the primary leaves of the Seedling present a circular or peltate form resembling those of the Holyoak, and the leaves that next succeed present an elongated and toothed form, showing a tendency to lobing or subdivision in a triple manner. This plant was in the latter condition. It was placed in deep soil at the upper and back part of a fernery in a somewhat limited space, flanked by a privet and lilac tree and backed by a wall of a building on which grew a pear tree, the foliage of which, projected forwards and screened the ground from the mid-day and afternoon sun. The open aspect was N.E. to E.S.E., and by the altitude of the sun from April to August, its direct rays would reach the plant till mid-day. The plant seemed to maintain itself feebly for the first year; the tap root had been somewhat injured in moving the plant. In the second year, 1886, it put forth a lower leaf and weak stem with a second leaf triple-pointed and lobed, but no flower-head was formed. In the third year, 1887, it further developed, producing a stronger stem with leaves, but still no blossom. On the fourth season, 1888, it issued from the ground (for it died down as each winter approached) with more decided vigour, and developed its magnificent leaves that place it in a front rank as an ornament to shrubberies. The season was cold and rainy, yet its growth was rapid and continuous from the beginning of May to the last week in June, when it quickly pushed out its large central umbel, and subsequently four lateral ones. It had then attained its full height and had penetrated the foliage of the pear tree. By the 9th of July the seeds were forming on the central umbel and the four lateral ones were in bloom; by the 16th July the bloom had fallen from all. The following measurements were then made:—

				FT.	IN.
The stem from its base to the base of the terminal umbel			..	9	-
Length of 1st Internode, from base to 1st stem leaf			.. ..	2	2
,,	2nd ,,	,,	1st stem leaf to 2nd	3	-
,,	3rd ,,	,,	2nd node to 1st lateral umbel ..	2	2
,,	4th ,,	,,	3rd node to 3rd ,, ,, ..	-	10
,,	5th ,,	,,	4th node to base of central umbels	-	10

Circumference of stem.

			INCHES.
At base, just below the base leaves		.. .. ..	$7\frac{1}{2}$
Below the 1st node		.. ..	$6\frac{1}{2}$
,,	2nd ,,	.. ..	$5\frac{1}{2}$
,,	3rd ,,	position of 1st umbel	$4\frac{3}{4}$
,,	4th ,,	,, ,, 3rd lateral umbels ..	$3\frac{1}{2}$
,,	5th ,,	base of central umbel	3

The nodes whence the leaves sprang were not measured in the circumference of stem, owing to the upward slope and partial grasp of the base of the leaf preventing a true line being taken.

The stem was ridged and grooved, rough with coarse hairs set in glandular bases, tinted purple, and was partially coloured of a purplish

brown on the side most exposed to light, in the two lower internodes. Thirty ridges were counted around the base, and 23 in the upper three internodes, they gradually became finer above and the grooves between them narrower and shallower. From the position of the plant the stem early acquired an oblique direction towards the open space where there was more light, it also formed a long upward curve in the lower part. By the weight of the advancing growth and formation of the inflorescence, the deflection became greater, so that a person of moderate height could reach the terminal umbel that should have been placed 9 feet from the surface.

Leaves.

There were two apparently opposite base leaves, the others being set, alternately, on the stem. They were all large and coarse with a wide expanse of the blade, which was deeply cut into segments, assuming a pinnate form, being irregularly serrate on the margin. The lower leaves were petiolate, the stalk grasping the stem by amplexicaul dilation that extended round the node in a partial and an oblique sheath In the upper leaves the blade sprang from this expanded portion, which had a tendency in some instances to become more stipulate and foliaceous. The leaf stalk divided in three lesser ones or petioles, a central and two lateral ones, from which the blades expanded. The main nerves of the blade had the same tendency to triple division, producing opposite lobes on either side of the expansion ; the next division was alternate and then the nerves became reticulate. The leaves were dark green above, light green beneath. The central division of the blade, both in the primary and sub-divisions, was the largest, and less pointed in form. The divisions of the blade in the larger leaves were marked by a space along the mid-rib which was winged on either side. The further observations on particular leaves have been condensed to save space. The *two base leaves*, though apparently arising from the same level, were not exactly opposite. The measurements varied considerably ; this was partly due to injury and obstructed growth in one of them. Arising out of the axil of the one which might be considered the lowest, appeared an attenuated small and more pointed leaf. By the triple sub-division of the leaf-stalk these basic leaves presented three separate sections, right, left, and central, all formed upon the same plan of venation with certain modifications adapted to the position and size or importance of the part. The central formed the largest and most important section. The *right and left* sections were similarly constructed. In the outer sub-division of each section it was noticeable that a subsidiary lobe was formed and a modification of the venation occurred to produce it ; the ternary division assumed a quinary one, by two of its secondary veins approximating the sizes of the primary, and passing obliquely backwards from their origin. The *central* section was more expanded, taking a somewhat palmate form ; the segmentation, indentation, and division of the parts, were more pronounced. The quinary ramification, already alluded to, was more marked and decided, and produced two lobes so reversed as to assume the appearance

of appendages to the lateral divisions, whilst the inner divisions, opposite, seemed lost or suppressed in the web edging the space occurring in the mid-rib and dividing the sections of the blade. This webbed space is 10½ inches long. Beyond this the quinary modification again occurs in the venation, producing an expansion of the blade that gives the palmate character to this section of the leaf. Measurements were made of the various parts, but are here omitted for the obvious reason stated before.

At the 1*st node* a leaf of similar form and construction to the basic leaves, was given off, but of less dimensions.

At the 2*nd node* the first part of the leaf-stalk was represented by a broad expansion of yellowish green and ribbed webbing that was rigid and stem-like externally, clasping the stem below; above, dividing into three stalklets or petiolets supporting leaf-blades. Instead of the cylindrical form of leaf-stalks below, these were prismatic.

At the 3*rd node* a sort of extended stipula was formed, from the tip of which extended short stalklets supporting much diminished leaves. The central stalklet was 1½ inch, the laterals ⅝ of an inch.

Axillary growths.

A miniature leaf in the axil of one of the basic leaves has been mentioned. In the axil of the first and second leafstalks an abortive or sessile leaflet was observed, that in the second was hid in the stipular formation. From the axil of the third there sprang the first umbel, the stalk of which was 22 inches; at 13 inches from the base of the stalk, a foliated stipular process divided into two parts, was found; the foliated part appearing on the upper edges, and representing a miniature leaf. In each part a stalked flower-bud, complete in all details, in one instance enveloped in a two-fold bract, and in the other a trifid bract, was revealed. At two inches above this another stipular process appeared, enclosing in a bifid case of the same colour a slightly stalked umbel-form. At the 4th Node appeared a triple foliate stipule, each portion showing a different degree of leafiness and size, but all in a much diminished degree compared with the stipule at No. 3 node. From the axil of each of the three sprang the stalk of an umbel. The stalk varied in length and thickness, in relative proportion to the stipules. The three stipules were whorled one within the other. At distances on the three-flower stalks, varying from 11 inches to 10½ inches, the peduncles themselves varying from 18½ to 17½ inches; there were placed stipules enclosing sessile umbel buds which were enveloped in secondary stipules; the outer stipules had more or less of leafiness at the tips, the inner ones were very slightly so, and had minute stalks. Two of these stipular bodies were bifid and one trifid, and each division contained an umbel surrounded by secondary stipules. These umbels, had they developed further, would have formed a third series of blossoms. They were particularly interesting as analogues of leaf-formation.

The Inflorescence and Seed.

The terminal umbel bloomed first, and the four lateral ones followed

in about a week; the lowest one taking the lead. By the 16th of July all bloom had fallen from the umbels. The seed was well set on the terminal or axial umber, but not so on the lateral ones. The umbels were now all suddenly stricken by aphides and thickly beset by them; the development of the seed of the lateral umbels was checked. The aphides began to appear on the 12th.

The outer rays of central umbel now measure from 9½ to 10½ inches.

The outer rays of the three central umbels below measure from 6 to 5½ inches.

The outer rays of the lowest lateral umbel measure from 7 to 6½ inches.

The central umbel has 64 rays and its diameter is 19 inches.

The diameter of the lateral umbels, with slight variations, is 15 inches. On the 17th of July the central umbel, with 7½ inches of stalk, was cut off, and was found to weigh 1-lb. 3-oz.* avoirdupois, the seed was fully formed.

When the umbel was thoroughly dry and seed beginning to fall off, (the 13th of September,) the umbellules were removed and the seed of each separately examined; such as was shrivelled, undeveloped, and without vitta, or insect-eaten whilst waiting to be counted, was reckoned as defective or abortive, the rest as fair. The general amount of seed on an umbellule varied from 85 to 31, the abortive from 14 to 21. The total amount was 3,230 seeds, of which 352 were defective or abortive, leaving 2,878 as fair seed. At the end of three months, the seed being thoroughly dry, the whole quantity of fair seed was weighed in 40-grain parcels, giving a total of 688 grains.

Comparison with plants of parent-stock.

In order to compare the plant under observation, which had grown under some disadvantages, with another better placed, a strong and healthy specimen was sought for in the ground whence this one had been transplanted. Many fine plants bloomed on that ground year after year for 20 years; the aspect was well open to the S., but was closed on the N. side by a high gaol wall with shrubs at the base, amidst which the plants grew. Plants in all stages of growth, according to their season, were growing under and in front of the shrubs. Several of the larger plants in bloom had four umbels arising together from the first node below the central umbel, the stalks of a few of these had small umbels springing from them at the positions where the stipulate bodies were noticed in the transplanted specimen, thus forming a third series of blooms, but their condition did not promise the formation of good seed. Most of the flowering plants varied in height from 7 to 8 feet. The tallest one was selected for special observation, it was bent down by its top weight as some of the others were, to an oblique direction. The measurement of the stem from

* Some of the aphides remaining on umbel may have influenced the oz.

base to below the central umbel was 10 ft. 2-in. The measurement across the blades of the base-leaves closely corresponded with that of the transplanted specimen, though slightly in excess of it. The stem and larger portion of the leaf-stalks were deeper and more extensively coloured, the purple rugosities were larger and the hairs projecting from them stronger. The leaf-stalk had a tendency to be ridged on the inner side, making the section ovoid instead of circular; on the edge of the ridge was a groove which opened out as it approached the blade. The mid-ribs of the blade and their branches were more prominent on the under surface of the blade. The upper surface was darker coloured, and more glossy. The central umbel, which had fully developed seeds, was removed for more complete examination. The outer rays measured from $9\frac{1}{2}$ to $10\frac{1}{2}$ inches, the diameter was about 20 being here and there more by projection of an outer umbellule. There were 73 umbellules, the fair seed on each varied from 81 to 21, the abortive seed from 13 to 1. The weight of the umbel, with $7\frac{1}{2}$ inches of the stalk, was 1-lb. $\frac{1}{2}$-oz.; no aphides were seen. The amount of seed was 3,541, of this 509 were abortive, leaving 3,032 as the amount of fair seed.

It only remains to add, that the transplanted plant seemed to be materially affected by the attack of aphides. The lateral umbels faded, drooped, and shrivelled up; and, though the vegetative growth of the other parts persisted for some time, the plant seemed to die down in the early autumn sooner than was expected. There was no re-appearance of it in the following spring. It would appear that the period of life of this plant is from 4 to 5 years, the beauty of its foliage extending and increasing over the three or four latter years.

III.

THE BEDS BETWEEN THE CHALK AND LONDON CLAY IN EAST KENT,

BY

Mr. G. DOWKER, F.G.S.

Read February 21, 1889.

In the paper, of which this is an abstract, Mr. Dowker gave a resumé of the chief papers by Professor Prestwich, Mr. Whitaker, and Mr. J S. Gardner, in relation to the lower tertiary beds of the district, with particulars of the most important natural sections that have been published by the authors above referred to relative to the subject.

He then referred, in some detail, to the three divisions which had been classed by Mr. Prestwich in the following order :—

1.—Thanet Sands.

2.—Woolwich and Reading Beds.

3.—Basement Bed of the London Clay.

With reference to the first of these, the Thanet Beds, the author remarked, the chalk, on which this bed rests, is considerably eroded, and in this district it is chiefly the newest, or Margate chalk with few flints, that is met with immediately under the Thanet Bed. In the Pegwell Bay section a considerable mass of tabular flints marks the junction, but elsewhere this is absent. More westward the chalk beneath the Thanet Beds contains more flints, and is, presumably, a lower part of the series. In most cases the Thanet Beds repose on an eroded surface of chalk, but the irregularity is confined to minor excavations; on the larger scale it rests conformably to the chalk strata. It is, nevertheless, apparent that the chalk had been subjected to some denudation previous to the deposition of the Thanet Beds. The latter have been deposited in a depression in a chalk basin formed at the commencement of the Eocene period. Comparing the thickness of the Margate chalk, in the Isle of Thanet, underlying the Thanet Sand, with the thickness of the same division of this formation nearer Canterbury, it would seem that the lesser thickness, in the latter case, must be due to denudation.

It was remarked that the junction of the Thanet Bed with the chalk is everywhere marked by the occurrence of green coated flints, and these follow the eroded surface down into the pipes and cavities of the chalk. These pipes in the chalk are apparently caused by the rain water finding its way down through the tertiary beds, and so dissolving away the chalk, and then the Thanet Bed sinks down into the pipe, carrying with it the superincumbent green-coated flints. There are not found more flints in the eroded pipes than at other junctions with the chalk; indeed, the chalk, for the most part, is so destitute of flints, that it would require a large amount of denudation by this means to account for the number of the green-coated flints. Another fact relating to this eroded surface of the chalk, was alluded to, viz., that in some cases the erosive action had been continued so as to bring down the drift from above to fill up the pipes, and in large pipes this was particularly the case. A very curious instance of this was noted in a Chalk Pit at the North-west end of the Elham Valley Railway cutting, known as Chapman's Chalk Pit, occurring at the slope or ridge of the chalk skirting the Valley of the Stour. In this large pipe the bottom and sides are lined with the Thanet Beds and junction bed of green-coated flints, inside of which the pipe is filled with subangular gravel, which forms some concentric layers of washed flints; in this case the further erosion of the chalk seems arrested at the close of the time when the drift was formed. The more recent gravel and drift above passing regularly over this pipe.

Of the green-coated flints it was remarked that there were two theories to account for them: the one advocated by Mr. Whitaker and Mr. McKenny Hughes, and the other by the Author. By a curious coincidence they both appeared at the same time in a letter to the *Geological Magazine*, in Vol. iii, pp. 216-239 and Mr. Hughes' in Vol. xiii, p. 18, of the Journal of the *Geological Society*. As Mr. Hughes' theory is the one generally accepted, his words are given in extenso:—

"The following observations have led me to infer that this bed is due to the decomposition of the top of the chalk, *after* the deposition of the Thanet Sands.

1.—The flints never show any traces of having been rolled or worn by the action of water, or broken up and weathered by any subaerial agency, but are, except in colour, exactly similar to those in places in the chalk.

2.—No fossils, except chalk fossils preserved in flint, have been found in it.

3.—Where a nearly continuous bed of flints, or a large tabular mass of flint occur, the base bed of the Thanet Sand seems to be arrested by it in a manner that would suggest rather the chemical decomposition than the mechanical erosion of the surrounding chalk.

4.—Where masses of chalk are embedded in or surrounded by the base of the Thanet Sand, this appears to be due to local undermining of the main mass of the rock, and not to be transported fragments re-arranged in a hollow.

Again; to look at the question from another point of view, it is highly improbable that it could be otherwise. As water charged with carbonic acid soaking through the Thanet Sand reaches the chalk below, it must decompose the surface to a certain extent; and if the water can pass freely away so that new supplies, not saturated with carbonate of lime, are brought to act upon it, that decomposition must go on *ad infinitum*."

On the other hand, in the letter to the *Geological Magazine* of May 1866, it was argued,

"That as there is a great break between the secondary and tertiary formations, it is natural to suppose that marine denudation had been at work during the interval, removing the upper part of the chalk: some such action might account for a bed of worn flints: but the angular flints could not be accounted for by this means. The occurrence of a semi-tabular broken flint points to upheaval and fracture. And re-cemented flints which are here found, would imply some slow action, during which the surfaces have been re-combined.

Should the chalk, immediately below the Thanet Sands, have been subjected to subaerial action previous to the deposition of the latter, organic matter would be deposited along with the products of the decomposition of the chalk, the green-coated flints being the result of the combination of iron, silica, and alumina during this process."

The author likewise pointed out, that the tabular flints which occurred between the chalk and the Thanet Sands, were, probably, formed *after* the deposition of the latter, being the result of the silica of the sand brought in contact with the chalk."

Since this paper was written it is more generally conceded that chalk flints have been formed subsequently to the deposition of the chalk by infiltration of soluble silica and re-combination with chalk. Mr. Prestwich long ago pointed out in the Thanet Sands long vermiform impressions of casts, apparently of fuci, and that the palœontological condition of the Thanet Beds points to *littoral* rather than to *deep sea* origin; and, also, it is suggested, that the pebble beds that occur so largely in the upper beds point to a large and deep wearing away of the chalk about this period.

The author quoted Mr. J. S. Gardner with reference to the conformability of the Thanet Beds to the chalk. where he writes:—

> "The Thanet Sands are as little conformable and had as little to do with the chalk, as the Goodwin Sands."—"The Thanet bed further shows that it must have been deposited within the depth to which the Laminarian Zone extends: and the imbedded sea-weed may well account for the peculiar character of the *blackish* green mud-like sediment in which the green-coated flints are imbedded."

Prestwich, likewise, was quoted in reference to this bed:—

> "That in burning it gives off ammonia in abundance, an evidence, he considered, of the presence of animal matter," and adds "This bottom bed might, of course, belong to a very much older period than the rest of the Thanet beds."

It was noted that closely associated with these green-coated flints, and in variable thickness, a bed of yellowish-drab sandy clay was met with, and although generally classed with the Thanet bed above, (differing but little in lithological characters from the immediately overlying sands) nevertheless, possesses some peculiar characters of its own, which may entitle it to rank as a separate formation, being destitute of any fossils by which it may be classed with the beds above, though it passes upward into Thanet beds with fossils. The bottom bed of Thanet contain a very curious assemblage of sand grains

Miss Gardner was quoted in a recent contribution to the *Geological Society* as giving some details of the sands associated with the green-coated flints in which she found:—

> "Quartz flint, Glauconite, and small quantities of Felspar and various rarer minerals; viz., Magnetite and Spinel, Zircon, Garnet, Rubite, Tourmaline, Actinolite, Calcedony, and casts of foraminifera. At Pegwell Bay this unfossiliferous bed is 19 to 20 feet thick. In other places it varies from one to two feet."

In the recent cutting in the *Elham Valley Railway*, East of Canterbury, the author remarked that this unfossiliferous Thanet bed is largely developed and appears in places nearly 30 feet in thickness, but, inasmuch as the clay drift above passes down so imperceptibly into the beds below, it is difficult to determine the entire thickness; there is, moreover, an entire absence of fossiliferous beds in the tertiaries of the entire cutting.

The author further observed, that *above* the before-mentioned unfossiliferous *base bed* at Pegwell Bay, and. generally, in the synclinal depressions in the chalk from thence to Canterbury, a dark tenacious clay bed was met with for the most part fossiliferous, containing Dentalium sp. Natica subdepressa, Modiola sp., Pholadomya cuneata, and Koninckii, Thracia oblata, Nucula Bowerbankii and Cyprina Morrissii, often only as casts; it was further noted that the more sandy beds of the Thanet series overlaid these clay beds and constituted a bigger zone, in which occurred tabular concretions of sand-stone, and occasionally, silicified shells or casts.

The beds resting upon these Thanet series, it was noted, although classed as belonging to the Woolwich beds, presented no *marked* character in lithological or palœontological features, but, nevertheless, may be recognised by the careful observer, by the characters indicated in the Geological Survey Memoirs.

The Author was rather inclined to the view of Mr. Gardner, who, instead of a three-fold classification of the beds in East Kent between the chalk and London clay, made but two, (separating the Thanet beds from the Old Haven beds, and classing the Woolwich series in East Kent with the Thanet below.) and to follow the latter gentleman in classifying the lower eocenes in respect to their marine estuarine and fresh water characters.

Attention was drawn to Mr. Harris' paper in the proceedings of the Geologist's Association, in some respects coinciding with Mr. Gardner's views, but classing the Old Haven with the Reading and Woolwich series, thus making, in fact, only two divisions instead of three, including the whole of the beds between the London clay and Thanet beds as one series.

The older Geologists, it was remarked, classed all the beds from the chalk to the London clay as one, under the term Plastic Clay series. It would seem to be rather a retrograde motion in these days of subdivision to adopt these comprehensive views; for practical purposes it is better to follow the leading of the writers of the Geological Survey Memoirs. The present notice of the lowest of these beds resting upon the chalk, led the author to adopt one *additional* division under the term of Basement Bed of the Thanet, which, he believed, had as good a title to a separate division, as those advocated by Mr. Whitaker. But, he considered, the most difficult part of geological science, was the correlation of beds of marine and fresh water character, where there had been oscillations of level accompanied by alternate marine and fluviatile conditions.

The Bibliography of the subject is added, which may be useful to the student.

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IV.

NOTES ON THE GREAT PIPE-FISH, (SYNGNATHUS ACUTUS)

BY

Mr. G. DOWKER, F.G.S.

Read December 9, 1889.

The following notes on the Pipe-fish, Syngnathus acutus, (*Yarrell*) which I have kept in the Marine Aquarium during the last three months may possess more than local interest.

I obtained two specimens of this interesting fish from Whitstable on the occasion of the visit of the members of the Quckett Club there on September 7th, 1889. The two specimens were young fish, the largest being about six inches and the other four inches in length. They were both turned out of the same haul of the dredge. When I took them home they soon recovered from the journey, and were quite at home in the aquarium, concealing themselves under the stones or weeds. When they came out from their hiding place, they often assumed an upright position in the tank, balancing themselves by the action of the dorsal fin, just bringing their mouths to the surface of the water. Suspecting this might be for the reason of a want of aeration of the water, I applied a syringe to the tank every morning. I found as the tank became purified, although they no longer came to the surface, they very commonly assumed the peculiar perpendicular attitude.

I should observe, that their mode of progression was not like that of other fish, the tail not being used to propel them, and the pectoral fins being small they used the large dorsal fin by giving it an undulating movement like a scull and progressed in this way very leisurely. They showed little signs of fear, even when any thing was placed near them; quietly keeping their heads motionless they had a peculiar way of rolling

their eyes about, and appeared near-sighted. After I had kept them till the 18th of October, and made several observations of their habits and mode of feeding, the smaller specimen died, having, as I believed, received a nip from the claw of a crab, which had been incautiously introduced into the aquarium with zoophites; however this may be, I did not immediately miss the specimen, and it had been dead some days and partly eaten when I found it. I now thoroughly cleansed my tank and let in more light, and it soon became brilliantly clear and healthy.

The large pipe-fish and a small double-spotted goby, which I obtained at the same time and place as the former, were now the sole occupants of the tank, and lived in health; and, I may add, in harmony together. I had some difficulty in knowing how to feed the fish. My kind friend Mr. Sibert Saunders, of Whitstable, sent me one or two parcels of fresh gathered sea-weed to turn into the aquarium for the purpose of being overhauled by the pipe-fish for animal life. I had read in *Yarrell*, that they lived on entomostraca, so I hoped to introduce these with the sea-weed. I found indeed the pipe-fish did take a lively interest in these newly introduced weeds, making, I might say, a perfectly microscopical examination of them; indeed, while so engaged, focusing its eyes alternately on different parts of the weed, it might have been taken for a veritable member of the Quekett Club. These eyes of the pipe-fish are large in proportion to the size of the fish, and a considerable space of head intervenes between them. They are directed rather upwards and outwards, and are endowed with considerable movement being partially stalked, reminding one of the stalk-eyed crustaceans. The fish uses one at a time, and thus, whilst making his examination, was just like a watch-maker making use of his monocular squint-glass to look into the interior of a watch.

As I could not be always troubling my friends to send me fresh sea-weed, living, as I do, some distance from the sea, I conceived a plan of feeding my fish on fresh-water entomostraca. I constructed a filter and filtered a considerable quantity of pond-water that abounded in Daphnia, or fresh-water fleas. These, when thus obtained, I turned into the tank and found they would live some hours in the sea-water, and were eagerly devoured by the fish. The goby getting the largest share of the spoil he would stuff himself out like any alderman at a white-bait dinner.

On all occasions, when the entomostraca were introduced, we watched with much interest the fish feeding; I say we, for several of my daughters took great interest in the fish. The short-sight of the pipe-fish, already alluded to, was further evident in these observations; while the goby would dart about from one end of the tank to the other after the fresh-water fleas, the pipe-fish merely moved leisurely till he neared the side of the tank and then assumed his erect attitude, the tip of his tail resting at times on the bottom of the tank, and in this position, he would survey the struggling fleas by bending his head downwards, and thus resemble a horse; indeed, it is a nearly related species to the hippocampus or sea-horse,

and bears a close likness to it. While the pipe-fish's head was so posed, he would focus one of his eyes on a flea next and above him, then, suddenly throwing up his head and drawing in the water at his pointed snout, seize his prey with a sort of snap-action, like a dog catching a small piece of food thrown to him. The pipe-fish would continue these movements for hours, and always took the same leisurely survey and focus of the object before taking it, somewhat like a chameleon taking a fly. I observed, that these fishes feed by day, never at night, when they are resting at the bottom of the tank. The larger pipe-fish, whose history I am recording, died on the seventh of December, having lived just three months in my aquarium. I can only suppose his death was owing to insufficiency of food or warmth during the last week's cold dark weather.

The family of pipe-fishes are noted for many interesting peculiarities. The jaws are united, forming a tube more or less cylindrical; the gills, instead of having the pectinated appearance of most of the other fishes, are separated into small round tufts which are arranged along the branchial arches, and the fishes of this family are therefore called *Lophobranchii*. These tufts are defended externally by a large hard operculum having an aperture in the connecting membrane at its upper and posterior part, and are further defended by the number of indurated sculptured plates, by which their lengthened bodies are covered.

According to *Yarrell* (2nd. edition, p. 434) *Syngnathus acutus* is found on many parts of our coast; sometimes at low water among sea-weeds, at other times in deep-waters. It is believed, that the habit of proceeding to deep water at two different seasons has reference to important changes connected with the production of its young. Mr. Walcott's observations are as follows:—"The male differs from the female in the belly from the vent to the tail fin, being much broader, and, in having, for two-thirds of its length, two soft flaps which fold together and form a false belly or pouch. They breed in summer, the females casting their roe into the false belly of the males." Mr. Walcott adds, "they begin to breed when only 4 or 5 inches long." Mr. Resso has noticed "the great attachment of the adult pipe-fishes to their young, and this pouch probably serves as a place of shelter to which the young can retreat in case of danger. He had been assured by fishermen, that if the young were shaken out of the pouch into the water over the side of the boat, they did not swim away, but, when the parent fish was held in the water in a favourable position, the young would again enter the pouch."

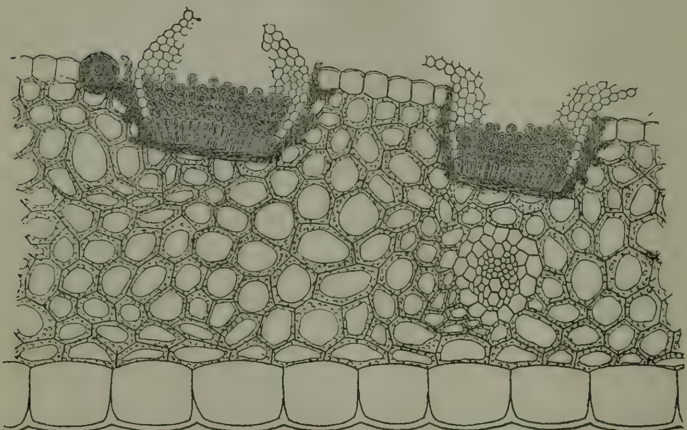
V.

NOTES ON THE LEAF-FUNGI OF THE YEAR 1889.

BY

MR. W. T. HAYDON,

Read MARCH 12, 1890.



During the past year all vegetation has fairly revelled in its season, and, as far as our neighbourhood is concerned, in its *proper* season.

If the conditions have been thus favourable to the growth of the higher orders of plant life, not less so have they been to the lower orders, especially the leaf-fungi. During the past year, I have gathered all the species found by me in any preceding year, and, in addition, 20 to 30 species I have not previously found, making a total of about 120 species. Several which I have been fortunate in finding, are considered somewhat rare. So numerous and so continuous were the growths, that but to very few could I devote special study.

In January, I found but two species of fungi affecting leaves. The first, *Œcidium smyrni* upon the Alexanders; the other, *Cystopus candidus*, a fungus sometimes making great havoc amongst cabbages and other cruciferous plants. February and March continued to afford a plentiful supply of these two, but added no others. During the month of April, the different species became very numerous; *Uredineæ* and *Peronosporeæ* being abundant. From thence, to the end of September, the number to be found at any one time was very great, and not till October was there any visible falling off in point of species; in quantity there was an abundance. Right on to the end of the year there was a plentiful

supply of nearly every family of leaf-fungi for study, and commencing with January, 1889, right up to the present moment, (March, 1890) there has not been a day on which I could not find at least one or two specimens.

As I shall confine most of my remarks to the order *Uredineæ* with its various forms, it will be well to give a general sketch of this interesting order. This fungus confines its ravages to living plants, principally affecting the leaves, but sometimes stems, petioles and organs of fructification. The fungus consists of a network of fine fibrous-like growths (termed mycelium) beneath the epidermis of the host, the mycelium traversing the intercellular spaces, piercing the cell-walls, and using for its own growth the protoplasm, elaborated by the host for its own use. The effect is to the host, sickness, and often death. It is no uncommon sight along our bank-sides and hedge-rows, to see the remains of some plant that has been reduced to a mere skeleton by the ravages of one of these leaf parasites. Very noticeable amongst these is the common mallow. (*malva sylvestris.*) Every bank during the last year bore some plants affected by this terrible pest. How rapidly these fungi are sometimes disseminated, may be gathered from the fact, that, prior to the year 1869, this fungus was unknown in Europe. Since then it has spread with lightning-like rapidity, causing great havoc in the flower garden among the cultivated mallows, as well as in the woodlands among the several wild species. It is no unusual sight to see the leaves of the common mallow riddled with holes, the fungus destroying the parenchyma of the leaf.

This is one of the few species having only teleutospores, which, if the conditions are favourable, germinate directly they are mature. The young plant has the power of piercing the epidermis of the host between the cells, or of entering by means of the stomata. The Enchanter's nightshade, ground-ivy, spear-thistle, *(carduus lanceolatus)* and the box, have each afforded me specimens of this section of the *Uredineæ* having only teleutospores. The common nipple-wort, marsh-marigold, bladder campion, dandelion, wood violet, moschatell, (*greater burnet saxifrage*) water mint, garden violet, and primrose, have afforded examples of *Uredineæ*, having the four sorts of spores, and all on the same host plant. The *Œcidium* of both, the bladder campion and marsh marigold are very rare ; of that on the bladder campion, I found but one infected area, two or three square yards in extent. Of that on the marsh marigold, I found but one or two leaves, but the *Puccinia* form was very abundant at Gibbons' Brooks, towards the close of the summer.

Very noticeable upon the wheat and many grasses, was a fungus known as *Puccinia graminis*. This belongs to a section of the *Uredineæ*, having the four forms of spore, but having its *spermogones* and *œcidiospores* on one host plant, its *uredospores* and *teleutospores* upon another. The *œcidiospores* of this particular parasite find their home on the leaves of the common berry. To this same division belongs a parasite, part of whose existence is spent upon the wild garlic or ransoms,

and the other part upon one of our woodland grasses. The sorrel also bears an *Œcidium*, the *teleutospores* of which are formed upon a grass.

The rarest find of the year belongs to this division, viz: *Œcidium Orchidearum*. This is a very rare fungus, and I have only seen two specimens, one gathered by my youngest boy while it was yet immature, the other found by my eldest boy some few weeks afterwards, the specimen being in prime condition. This specimen was figured in the September Number of "Life Lore" for last year,* but described as being found upon *orchis latifolia*, whereas it was upon *orchis maculata*. I may say, that, together with my children, we *examined* nearly 3,000 orchid plants last year, and only found the two specimens mentioned.

A division of the *Uridineæ* having only *uredospores* and *teleutospores*, is represented by specimens found upon the wild plum, (*prunus spinosa*,) *water persicaria*, and *lychnis diurna*. The division having *spermogones*, *uredospores*, and *telentospores*, is represented by specimens on the field thistle, carline thistle, and knapweed.

Another division bearing but *teleutospores*, and which do not germinate until after a definite period has elapsed, is represented by several species, the most interesting to me being that on the golden rod, not only on account of its rarity, but because it was the first plant upon which, some seven or eight years ago, I discovered *teleutospores*.

Puccinia smyrnii is a fungus belonging to a division of the *Uridineæ*, having *œcidiospores*, *spermogones*, and *teleutospores*, and occasionally, here and there, a few *uredospores*. This fungus is one which I have specially studied for several years, the last 18 months having specimens almost under daily observation. It is certainly one of the hardiest of leaf fungi, for on the young shoots that begin to peep above ground during the last few days in September last, this fungus appeared in its *œcidium* form, and from then right on to the present time, through frost and snow, this *œcidium* might be found. The *teleutospore* form, until last year, occurred but sparingly. Several years I did not succeed in finding a single specimen, although no doubt they were there, but during the months of June and July last, it was scarcely possible to find a leaf without *teleutospores*. This will account for the abundance of *œcidiospores* this winter; for the numerous *teleutospores* upon the ground and amongst the decaying vegetation, are conveyed to the young leaves by the wind and rain; there they soon germinate and enter the leaf, either through a stomata, between the cell-walls, or even pierce the cell-wall itself.

At the end of February this year, vast quantities of *teleutospores* had developed upon plants already bearing *œcidiospores* and *spermogones*, and are still in the same condition. It is very interesting to witness the insertion of the germ-thread or mycelium sent out from the *teleutospore*

* By the kind consideration of the Editor of "Life Lore," the illustration of this specimen is given at the head of this paper.

into the stomata of the host, and trace its course in a section of the leaf after entering Various forms under the names *lecythea*, *phragmidium*, *coleosporum*, *uredo*, *xenodotus*, &c., are to be found in plenty; the orders *Roseaceæ* and *Rubiaceæ* affording suitable nidus for numerous kinds. Under the name *Melamspora*, we find fungi on the cathartic flax, various species of salix, St. John's wort, willow herb, enchanter's nightshade, &c. The thistles and other families of the order *Compositæ*, afford homes for a host of fungi too numerous to mention.

I have instanced but a few of the many interesting and diverse forms of this very remarkable division of plant life, and will conclude with a few remarks on another division of microscopic fungi known as *Peronosporæ*, to which division belongs that fearful pest known as the Potato disease. Of the twenty-six species known in England, I have this year found in the neighbourhood of Dover, no less than twelve, it being remembered that of the twenty-six, three are regarded as doubtful species, and four comparatively rare; the finding of twelve is proof of their wide dissemination. The plants on which I have found *Peronosporæ* are, the potato, common nettle, spinach, field pea, creeping ranunculus, purple nettle, cultivated and wild cabbage, nipple wort, wood-anemone, poppy, dock and hedge parsley, in all, twelve.

In addition to the genera and species mentioned, I have a large number I have not yet been able to identify, making altogether about one hundred and fifty species gathered for the one year.

I know of no more interesting pursuit than a minute fungus hunt, a sport that may be enjoyed at all seasons of the year, the spoils of which afford a never-ending source of admiration for their beauty, and of wonder for their peculiar and intricate modes of growth and propagation.

Short List of Leaf-fungi found during the year, 1889.—*M. C. Cooper's arrangement.*

Rœstelia lacerata	Phragmidium obtusatum	Lecythea ruborum
Peridermium pini	Puccinia lapsanœ	,, rosæ
Æcidium leucospermum	,, menthæ	Ustilago antherarum
,, quadrifidum	,, malvacearum	Peronospora infestans
,, albescens	,, clandestina	,, nivea
,, epilobii	,, sparsa	,, pymæa
,, tragopogonis	,, syngenesiarum	,, gangliformis
,, euphorbiæ	,, virgaureæ	,, parasitica
,, periclymeni	,, circii	,, viciæ
,, calthæ	,, symrnii	,, effusa
,, pimpinellæ	,, calthæ	,, urticæ
,, urticae	Uromyces concentricus	,, ficariæ
,, behenis	Uredo potentillarum	,, lamii
,, compositarum	,, hypericorum	,, trifoliorum
,, violæ	,, confluens	,, obliqua
,, primulæ	,, bifrons	Uncinula bicornis
,, orchidearum	Coleosporium tussilaginis	Erysiphe martii
Phragmidium mucronatum	Melampsora euphorbiæ	,, montagneii
,, bulbosum	Cystopus candidus	,, horridula
,, gracile	,, cubicus	

VI.

REMARKS ON THE OTOLITHS OF CERTAIN FISHES,

Extracted from a paper read before the Dover Field Club and Natural History Society, 29*th January*, 1890,

BY

Mr. SYDNEY WEBB.

The mechanism of the human ear consists of an outer organ with convolutions for the purpose of arresting and detaining sounds, and an internal series of complex arrangements for their conveyance to the brain.

To effect this, there is a receiving tube closed at the inner end by the tightly-stretched membrane we usually call the drum, behind which is a little chain of bones, the last of which is stirrup-shaped and fastened to another thin skin which closes the cavity within which these bones are placed Beyond the stirrup is a bony chamber in which are winding passages; from its fancied resemblance to a snail-shell the spiral part of this organ is called the *cochlea*. All the passages and tubes are filled with a watery fluid. The nerve by which sounds are communicated to the brain, extends from *it* to this winding chamber, and the extremely sensitive ends are ramified and spread throughout the passages and cells.

From the outer ear, the vibrations pass down the tube to the drum, which latter (like the tinfoil curtain of the telephone) communicates the infinitely minute air wave to the chain of bones, these set the fluid into motion within the winding passages throwing it into undulations, which, acting upon the nerve, produce the complicated phenomenon we call hearing.

On either side of the skull of a codfish, within the cavity, lies a small bone detached from the others, slightly curved and flattened, of an elongate oval shape. This is the otolith, or receiving medium, which corresponds to the cochlea in man, and the same term might be used as instancing the same relative functions, were it not for its very dissimilar appearance. It is often called, in ignorance, a shell, thus oddly enough associating to itself the English meaning of cochlea. It is to the diversity of form in these bones I propose to direct your attention.

There is much difference in opinion amongst anglers, whether fishes really hear or not. One argues that they will almost listen to a conversation about the bait and mode of attack, and act accordingly; whilst another lays too much stress on the vibration of the ground from approaching footsteps, as the sole cause of taking alarm. That some fishes have this sense very well developed has been fully proved, and those persons who study the otoliths of purely fresh water fishes, such as roach, tench, bream, or carp, will notice a complication of structure over

those of marine habits for an evident purpose, and that purpose must be an increased susceptibility to external sounds beyond those in their native element.

As to the position of the otoliths within the skull in a state of nature, it is difficult for one without anatomical knowledge to speak positively; but by an inspection of carefully dried heads, I am inclined to think they are almost invariably suspended lengthways and edgeways, in a horizontal, but somewhat leaning position. In the majority of instances the larger end of the otolith is directed forwards, but there are many cases in which this is reversed. No two species of fishes have them identical in shape even when closely allied, and the difference is often particularly marked in those examples most nearly related to one another, thus it is claimed that *a knowledge of these bones will afford a very reliable subsidiary test for the discrimination of species.*

It is, of course, impossible to point to the otoliths of any particular fish as types, or to describe specimens in any progressional order, but as those of the cod (*Gadus morrhua*) are known to many who have seen no others, it will be convenient to start with this fish.

The first three figures on the accompanying plate, show in outline, (natural size) the form of this fishes otoliths, and the first thing we notice is, that notwithstanding the growth of the fish from the immature codling of a total length of fourteen inches, to the deep-sea adult with a head alone of upwards of nine inches, there is but little relative difference in the size of these bones superficially. Age gives breadth and thickness, but scarcely adds anything to the length of the otolith, whilst the larger end becomes more truncate, and the wrinkling disappears in a great measure; the obtusely toothed edges too, are no longer so prominent, but the longitudinal fissure is deeper and broader. It must not be assumed from this change that the fish, like an old countryman, becomes "hard of hearing," but rather that this unevenness of surface is not given like our outward ear for a gathering of sounds, so much as for the attachment of the nerves, and therefore, no longer required when the fissure is deepened. It cannot be that more acute hearing power is required by the young in shallow waters, than when as larger fishes they go to greater depths, because if this were so we should find the same fact to hold good with other species, and this is not the case. We further see that the difference between the sexes is markedly shown, the broader and shorter otoliths always belonging to the female fishes.

From the codfish to the haddock (*Gadus æglefinus*) is but a step, but a very different style of otolith awaits us. Its position in the skull is the same as the cod, and like that fish, the broader end points forward, but there the similarity ceases. The sides are parallel instead of uniformly swelling outwards, the rugosities have almost disappeared, and the teeth along the edge of the lower side are more regular and very much slighter, the upper end is abruptly slanted off, and the opposite extremity obtusely pointed. There is no perceptible difference in the otoliths as the fish gets older.

Extremely close to the haddock, if we attempted to class fishes by their otoliths, comes a fish with a whole catalogue of local names—the coal-fish or rauning—that is, ravenous pollack (*Merlangus carbonarius*) not to be confounded with the common or whiting pollack, or cole whiting. Although the head of a fully-grown specimen weighed several pounds, the size of the otoliths obtained from it were but little longer than those of a haddock, but they are thicker and of more robust a type, also slightly different in shape, whilst the furrowing on the outside is very deeply marked. No one would hesitate from their general resemblance, to place the two fishes in one family, but the otoliths of our other two species have no such resemblance, either to themselves or any other member of it.

The common whiting (*Merlangus vulgaris*) has a very peculiar otolith. Like those we have just been considering, the larger end is directed forwards and this end is rounded and slightly knotched, and the very delicate and minute denticulations are prolonged on the lower side as far as the apex. For about the total length that a similar bone from a haddock would occupy, the sides are parallel, but from this point, that of the lower side inclines upwards at an angle of about 20° until it joins the other, the extremity of the otolith is thus produced to a point giving a total length to the bone of upwards of an inch. This bone being much more thin and slender than those already described, is very brittle, and easily broken. The surface is uneven, which, in the absence of rugosities, affords an equally good holdfast for the nerves.

The whiting is decidedly attached to shallow feeding grounds, so that good organs of hearing are absolutely necessary to them.

Throughout the autumn and winter, we notice that small haddocks, upon fishmongers' slabs, frequently acquire the reprehensible habit of twisting themselves around and getting sold as substitutes for whiting, and as spring approaches, another of the family does the same, this is the pouting (*Gadus luscus*) the otoliths of which tell it at once, as they have most distinctive characteristics. Shorter and stouter than any of those we have been considering, they irresistibly remind us of a child's eye-tooth. The thickness is almost one-half of the length, the end abruptly pointed, and the few rugosities (very marked) extend only half-way towards the tip. The difference between the bones in these two nearly allied fishes is indeed startling.

Although surprised at the variation this small group of fishes had afforded, my delight was increased by securing the otoliths of a hake. (*Merlucius vulgaris.*) This fish is furnished with an unequally sized pair of still larger dimensions than any yet met with, somewhat after the pattern of those of the whiting, but elaborated. Up to this time some disappointment had been felt that the larger fishes had not otoliths in proportion to their size but this was to be an exception. The ear-bone is particularly thin and brittle, nearly an inch and three-quarters in length, by six-tenths of an inch in its widest part. Viewed from within it is falchion-shaped, or might otherwise be likened

to an arrow-head with its point bent to one side, and the barb on the left side at the base broken off. It is beautifully denticulated near the end, the lower side particularly so, but the upper or outer portion is the most remarkable, the bone there is flattened in a very singular way, so that the specimen might almost be taken for a carving in ivory rubbed down for thinness.

Passing to another genus of the same family will be noticed the otoliths of the rockling (*Motella vulgaris*) a fish of essentially different habits to the last, frequenting as it does, still waters with rocky surroundings; a curious looking object, having, not only filiments from the lower jaw like the cod, but several additional ones standing out from the upper one. The otolith is long, narrow, slightly twisted, and almost devoid of interest. It is figured for the sake of contrast only.

The tribe of *Abdominales*, so named from the position of one of the fins, comprises with us three families of fishes, familiar instances of which are the herring, salmon, and flying-fish, the latter only an occasional visitor. In this group the position of the otolith is reversed, the pointed end being in front.

The herring tribe it is well known travel in company in vast numbers, individual shoals being of the same age Reasoning upon evolution principles, specimens of creatures so acting, would not require their faculties so keenly strung as though they had to gain each one its own separate livelihood; for the survival of the fittest means, also the degradation of those least able to bear the vicissitudes of life, and disused members it is said become abortive. The unwanted ears should then become smaller and smaller until lost altogether. The experiment then was interesting to obtain otoliths bearing on the subject. Certainly they favour the theory in some degree.

The ear-bone of the herring is unusually small, flat on the inner side but slightly convex on the exterior, shaped like the extinct hamite, a hook bent upon itself with the outer edge distinctly toothed, and only one-fifth the length of that of a haddock of the same size.

As the same argument is applicable to the mackerel, we may consider that fish now, although belonging to another tribe altogether, in it the bone is reversed in position to that of the herring. This is relatively the smallest otolith of all, being narrower, thinner, and more delicate. Much the same shape it is true, but bent, and with the projecting pointed end more produced. They are difficult to extract without breaking.

Last winter some sardines were forwarded me direct from the South of France, and I was able to compare them with their more humble relative, the British sprat. The conclusion I came to was inevitable. Only those who have never seen the fishes could have ever thought them identical. Not only is the sardine a much wider fish across the back, but it has a longer snout, larger skull, and quite different otolith. A miniature herring in fact, and its ear-bones, show these fishes to be

much more nearly allied than the sardine and sprat, for the otoliths of the latter fish are not more than half of the length of its aristocratic relative, and much broader and rounder in proportion, placed with the smaller end directed forwards. Those of the sardine are curiously suspended, like the clapper of a bell. These are the smallest fishes the otoliths of which I have endeavoured to extract.

The salmonidœ, (which takes its name from the king of fishes,) is a rather large family even in British waters, yet but two examples only, the salmon and smelt, appear in our local shops. Their otoliths are not very unlike one another, if one can fancy the narrow end of that of the smelt produced, as is that of the salmon. That of the smelt is a very pretty object, irregularly oval or leaf-shaped, with a deeply-knotched outline, whilst the salmon may be said to have its otolith somewhat pistol-shaped. It will have been noticed that in all the otoliths, the upper side is but little curved outward from a line drawn from end to end, whilst the other or lower side always is more rounded, so that as in the herring or mackerel, a fine point or tail is produced by this rounded edge, early approaching the fissure, and thence proceeding nearly horizontally, but as drawn in the plate, perpendicularly to the extremity. It is from the position which this side first assumes when it projects outwards, that the main differences between the otoliths of this group are most easily recognized. Thus in the fresh-water herring or pollan, almost peculiar to Ireland, this rounded side, although starting below, rises slightly higher than the apex, the salmon has the apex decidedly higher, but exactly the contrary may be observed in those of *Coryyonus*, the snout-fish of Holland, a fish unknown in the London markets, until the Dutch eel-boats brought specimens over a few years ago. The otoliths of this fish are thick in proportion to its size, but not so much so as those of the cat-fish, (*Anarhichis lupus*) from its immense mouth and formidable teeth, sometimes known as the wolf-fish, the otoliths of which have some points in common with those of the salmon, they are small in size, not exceeding two-tenths of an inch in length.

When we investigate the flat-fishes, we find another shape altogether. From the natural habits of these fishes, we should not feel surprised if one of the otoliths were wanting altogether, or degraded to a minute travesty of the other, but, as is well known, by a twist of the vertebra where the neck joins the skull, the organs for both sight and hearing are brought naturally into play, and there is no difference in the size of the internal bones. Living almost entirely at the bottom of the water, assimilating the surroundings in hue, and partly concealing themselves in the sand, can they need to hear much, or at all? and should we not expect to find the otoliths like those of the herring and its allies, reduced to a mere nothing?

But evolution will not assist us here at all. The otoliths are well developed, and what is more, approach those of the majority of fresh-water fishes in shape.

The simplest form perhaps belongs to the plaice (*Platessa vulgaris*) which nearly approaches that of an oval, but the usual straight side causes the lower end to be the smaller, whilst there is near the top, a small projection. The concentric lines of growth in the otoliths of the flat-fishes are readily discernible, and certainly make the bones somewhat shell-like, so as rather to resemble the operculum of a gasteropod, for instance, the horny brittle covering, with which a periwinkle upon withdrawing itself into its shell, closes the aperture. Like the already-mentioned examples, this otolith is minutely toothed, or sculptured around the margin.

The oval form of the otolith of the brill (*Rhombus vulgaris*) is broken by the top being much flattened and indented, the centre may almost be considered a notch, both sides are rounder than usual, but the symmetry is spoiled by the bend inwards on one side near the small end.

The otolith of a small turbot is a very beautiful object. It has but a slight resemblance to that of the brill, the larger end having the indentation much larger and wider, the underside the straighter for some little way, then it abruptly turns first down and then upwards, thus making a sharp tooth. The scalloping of the edges is continued all round, and well marked, which gives the bone a delicate shell-like appearance. In an old fish the sculpturing is wanting, except upon the rounded side, the indentation at the larger end becomes a notch, and the straight side is so sharply cut off at an angle to the end of otolith, that the tooth is scarcely seen. This very peculiar arrangement is so suggestive of a portion having been broken off, that I threw several specimens away before satisfying myself that I had not injured them in the extraction.

All these otoliths agree with one another in the respective fishes, that is, there is no perceptible difference between the corresponding bones of any one fish, but it is not so with those of the holibut (*Hippoglossus.*) In this fish there is a marked variation. The otoliths are small for the size of the fish. Those obtained from a head eight inches long, with an internal skull of five and a half inches, measured only six lines, or about the size of those of a medium brill. They are thicker in the middle than the sides, and this is further reduced in the centre of the lower side and each end, by a groove as it were gouged outwards from the middle. That on the left is wing-shaped, but not so decidedly so as is the otolith of the turbot, the depression at the larger, or posterior end, not so deep, but the upper side of it rises considerably beyond the other whence its outline makes an obtuse angle to the smaller end. The lower side does not rise abruptly, forming a tooth as in the turbot, but curves in two equal bends to the apex. On the outside, the depression for the attachment of the nerves is broad and deep. The right otolith much more favors that of the plaice in shape, but the notch at the end has a projection in the centre, which, without filling it up entirely, sufficiently protrudes to make the end of the bone look rounded instead of indented. This otolith is flatter, and less wrinkled than the other, and the edges more regularly carved from end to end. An examination of several examples of this

fish, has satisfied me that these differences are not of exceptionable, but usual occurrence.

The otolith of the sole (*Solea vulgaris*) is thick and short, it is without any sculptured markings, and is cuirass shaped, not unlike one of the plaices' otoliths, cut in a curve across the middle.

The lemon sole (*Solea pegusa*) has this bone more circular, and of almost twice the thickness. On either side of the curved end are two deep wrinkles, which are entirely wanting in the other species.

That nondescript, or rather nonplaceable creature, the eel, has small otoliths, as we should expect, from the head. They are very like those of the flat-fishes, but curved inwards, their shape is oblong with the corners rounded.

In the fresh-water fishes of our streams, another arrangement takes place altogether; indeed I am not sure whether or not a second otolith is part of the economy of hearing as well as the bone I have now described, but my opportunities of investigating these fishes have been but slight, depending indeed upon my friend Mr. C. A. Briggs, formerly of Folkestone, but now of Leatherhead, to whom I am indebted for nearly all my specimens. In these fishes the otoliths are mostly of an irregular circular shape, they differ from those already mentioned considerably, for instead of a simple denticulated edge, the rugose markings assume a distinct and regular series of convolutions over the body of the otolith, so like our outward ear that they are no doubt instituted for the same purpose, viz: the collecting and retaining sound. Several of these are figured in the plate which accompanies this paper.

I have not found otoliths amongst the cartilaginous fishes, or amongst those whose skull is of a cartilaginous nature. Of the former of these the skates and dog-fishes are well known examples, whilst the Doree will represent the latter. The enveloping medium which takes the place of a true skull in these fishes, is of great thickness of a necessity, to compensate for the loss of the bone, whilst the cavity within is small in proportion. Doubtless it is there in some shape, although at present it has escaped me, for the dog-fish has the reputation of some sagacity which pre-supposes the power of hearing.

Apart from their connection with the fish itself, I am not aware of any inherent quality, either for use or mischief, that may attach to these bones, excepting as the playthings we used them for when children, but formerly many objects were considered to have virtues which are not now assigned to them, and the otoliths of the cod-fish crushed to powder were at one time thought to possess curative powers, and as such were eagerly sought after by persons afflicted with calculus.

Although I could carry my examples of variation of these bones amongst kindred fishes much further, I have sufficiently proved the argument with which I started, that an investigation of them will not only be of use in enabling us to clear up such doubts affecting

existing named species as those I have mentioned in the case of sprat and sardine, but would by inference throw light upon fishes habits in nature, (where we cannot follow them) and elucidate statements as to their modes of life, now freely made and accepted, although in many cases these may be but mere hypotheses.

My thanks are due and now acknowledged to my friends Mr. Howard Vaughan, of London, and Dr. Marshall, of this town, who, bearing in mind my requirements, have ever been ready in assisting me by forwarding specimens of fishes they thought might be useful.

The plate which accompanies this paper is, in many respects, unsatisfactory. The following are the chief inaccuracies:—

The words male and female should be beneath the first two examples in Fig 1, the other is a lateral view.

The Figs 16 and 17 are transposed, and the indentations of 16 exaggerated.

The outline of Fig 19 not sufficiently smooth.

22 should represent the otolith of the eel, but is really unlike anything with which I am acquainted.

Letters N S mean natural size.

Fig 18 is a curiously unusual shape of the otolith of a young turbot. They are generally more wing-shaped.

VII.

A NEOLITHIC "FIND" NEAR DOVER,

BY

MR. W. T. HAYDON.

The "find" was made in a field to the right of the Hougham road, about half way between the parsonage and the hill upon which the windmill stands.

It was noticed during a period of continued drought, in the summer of 1889, that on certain spots, the crop of lucerne fared badly and finally died off. Upon digging into the soil to ascertain the cause, it was found that in some places there was not more than about a foot of soil, and this lay upon a vast quantity of flints. Two men were employed to dig them out, a work which occupied them nearly the whole winter. The stones were used for road material.

It was towards the end of January, 1890, that I first knew of the removal of the flints—200 or 300 loads had then, I believe, been

removed. A brief examination of the spot convinced me that I should be repaid for careful search.

On Wednesday, Feb. 5th, 1890, accompanied by Mr. A. Wheeler, we visited the excavation, and, as far as was then possible, made a thorough examination. The finding of a few fragments of charcoal by Mr. Wheeler encouraged us to continue our search, resulting, on that occasion, in finding a few pieces of pottery, and a few fragments of bone.

From the men we learnt that they had found a very large tooth, (which they believed to be an elephant's,) a large limpet shell, and a few pieces of bone; nothing else had attracted their attention.

On this, and many subsequent visits, the following observations and "finds" were made :—The mass of flints occupied a very slight hollow in the hill side, was about 100 feet long, and 20 feet wide, but somewhat irregular; the length lay in the direction of the valley.

The greatest depth of the flints was, by actual measurement, six feet; towards the lower part of the slope they thinned out, while the upper side terminated in several places quite abruptly, and was, at these terminations, from three feet to four feet deep. The first foot of flints, measuring from the surface, was more or less mixed with soil, but below that, and reaching to the hard clean surface of the chalk, upon which the flints rested, was perfectly clean. excepting a layer of soft clayey deposit, about three inches thick, which lay directly upon the surface of the chalk. It was in this clay that we found the fragments of charcoal and pottery, on the occasion of the first visit, and which, on other visits, yielded us several leg bones of the horse (?) One tooth, unmistakably belonging to a horse, (as did also the one previously found by the men), and two other teeth, possibly also of a horse; seven pot-stones and several pieces of pottery, together in one cluster. The pottery was of the unbaked, or but partially baked, kind. One piece was ornamented with parallel lines close together. Several rounded (apparently water-worn) pieces of lower green sand, some small pebbles, possibly of Tertiary origin; two limpet shells (Patella vulgata), these are peculiar as being of more acute angle than those now found on the shore. The angle of the shell of the existing species, taken in its longest dimensions, varies from 60° to 90°, while the angle of the two found is 56°. They are also somewhat thicker than the existing specimens; this peculiarity may, however, be accidental. One oyster shell was also found.

The most valuable objects, however, are two flint implements, one that might have been used as a chopper, it being thick and heavy, five inches long, two and one-eighth inches wide, and one and a quarter inches thick at the thickest side—the opposite side is chipped to a rough cutting edge. No such implement is described in Evans' celebrated work. The other is a skilfully fashioned fabricator or chisel, four inches long, similar to that illustrated by Evans, on page 156 of his "Stone Implements." Two very rough flake-scrapers (?), and two small cores were also found. Scattered among the stones, but principally embedded in the

clayey bottom, there were great quantities of shells of *H. cantiana*, *H. ericetorum* and *Cyclostoma elegans*. These possibly were washed into and through the interstices of the flints, and reaching the bottom, thus became embedded in the clay. The whole of these "finds" were made in the clayey layer below the flints. The flints, shells, &c., near the base were, in many places, forming into a breccia, by the deposit of lime dissolved from the soil.

The "find" suggests several queries. First.—How came such a large quantity of flints (about 600 loads) together? Were they washed in by an excessive rainfall? Has the chalk been dissolved from beneath them, or have they been placed there by man? If they were washed in, a great body of water, operating in a short period of time, would appear to be necessary, and such a body of water would, in all probability, have removed all traces of man's work from the surface long before the flints could have been deposited. Then.—How came the implements, &c., beneath the stones? That they were used upon the spot there can be no question; such a collection could not have been brought together haphazard, for whatever may be said with regard to the bones and implements, the pottery, pot-stones, and charcoal, having been found in one spot is sufficient evidence of they having remained undisturbed since used by man.

The position of the "finds," viz., beneath the flints, preclude the possibility of sub-aerial denudation. The flints filling the depression are not such as are scattered upon the surface of the soil, they are all large, and from their clear and unweathered appearance, with their fresh looking fractures, they must have been torn from their original position in the chalk, and at once subjected to much rougher usage than they would have received if simply removed from the surface and cast into a great heap.

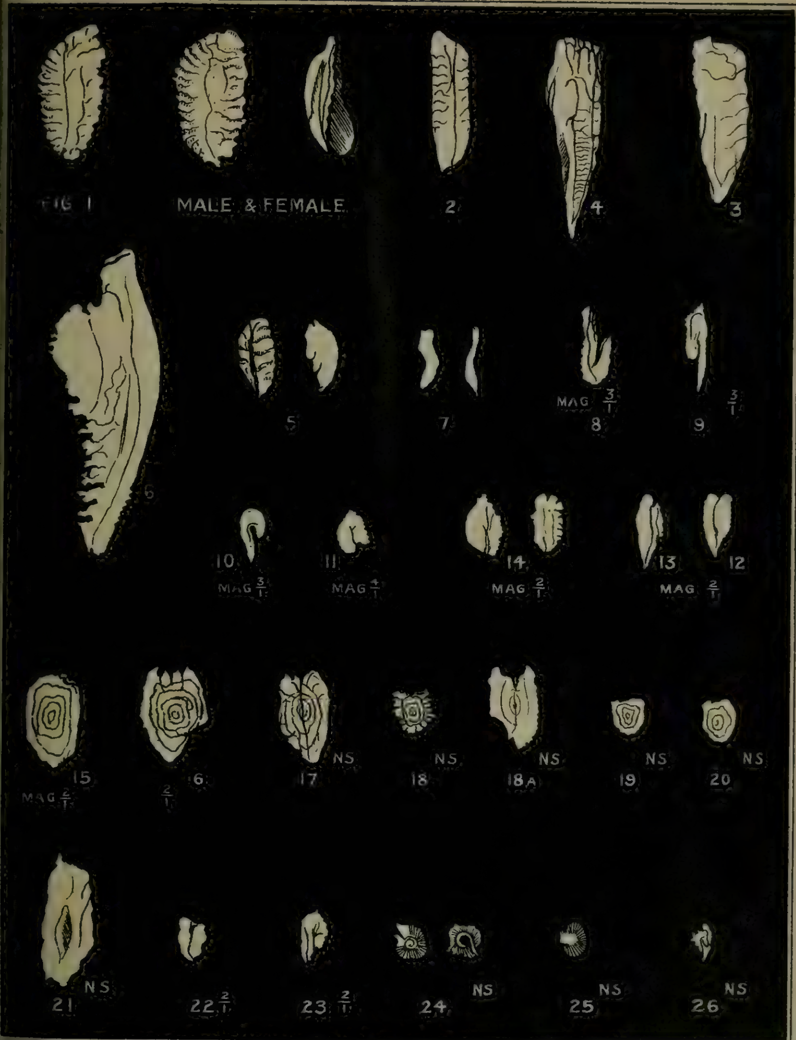
As a possible solution to the above queries I would suggest that the depression in which the flints were found is the remains of a "hut-circle" or series of "hut-circles" that date back to neolithic times, for the abrupt termination of the soil, where it rests upon the bed of flints, suggests previous excavations. Denudation has, it is true, removed all such traces from the surface, as well as the consequent tool-marks in the chalk, if such were there, and at the same time more or less destroyed the shape of the openings that presumably were made, but the clearly cut sides remain. The irregularity of the outline, together with the fact, that at a short distance from the main deposit of flints, another, but much smaller, was found, adds confirmation to the idea of a series of "circles." If this supposition is correct it will account for the preservation of the handiworks of man, even though the flints were washed in by some deluge of water.

The fact of the various objects being protected by the sides of the excavations forming the "hut circle," is sufficient to account for this.

Now as to the method of deposit. That water, if in any quantity,

is capable of washing such large quantities of flints from the chalk, there can be no question. But, whence the water? A very remarkable instance of the power of water to remove flints and erode the chalk is recorded in the Quarterly Journal of the Geological Society for May, 1889, as having occurred near Ightham, on July 31st, 1888, when, as I am informed by Mr. B. Harrison, about four inches of rain fell in one night! This quantity, congested in certain lanes, tore up old water-courses and eroded the chalk, carrying immense quantities of flints great distances, and distributed them over large areas of ground, to the thickness of several feet! Such a rain-fall, or series of rain-falls, would be competent to carry the stones found in the Hougham valley. That this deposit must have occurred very many years ago, may be with some degree of certainty, asserted; the large accumulation of snail shells, and those of such species as have their habitat on downs and heath-lands, points to a time long before the land was cultivated, and when there could have been but a few inches of soil at most covering the loosely deposited flints. I have no information as to when the land was first brought under the plough, but it must be many years ago, the accumulation of the one foot, and in some places of two feet of soil above the flints, points to a long period of time having elapsed from the depositing of the flints to the present.

Whether the above is a correct solution of the problem or not, I am of opinion that any explanation of the hypothesis must answer the two important queries, viz., How the objects came beneath the flints; and how the flints got there?



1.—Cod.
2.—Haddock.
3.—Rauning Pollack.
4.—Whiting (full grown)
5.—Pouting.
6.—Hake.
7.—Rockling.
8.—Herring.
9.—Mackarel.
10.—Sardine.
11.—Sprat.
12.—Pollan.
13.—Salmon.
14.—Smelt.
15.—Plaice.
16.—Holibut.
17.—Brill.
18, 18a.—Turbot.
19.—Sole.
20.—Lemon Sole.
21.—Grey Mullet.
22.—
23.—Cat-fish.
24.—Bream.
25.—Tench.
26.—Trout.

NOTES.

Shark at Dover.—On the 16th of October, 1889, a very fine example of the Porbeagle, or Beaumaris Shark, was exhibited on a barrow in the streets of Dover. It was stated to have been captured a day or two previously, off Folkestone, by the crew of a fishing boat, and was secured with some difficulty, after doing great damage to the nets. It measured 9-ft. 3-in. extreme length, and was said to weigh nearly 4½ cwts. As the usual length of an adult fish is about 10 feet, this specimen would probably be nearly full grown.

A Great Success.—Coal has been found near Dover, if not enough in quantity or quality to prove remunerative, yet amply sufficient to warrant further outlay of capital, and a convenient peg (much wanted) upon which to hang any amount of newspaper articles, geological lectures, and surmises. *This great success* has, from the first, been surrounded with mystery, and the utmost care has been taken to prevent the public from knowing any of the results of the boring. At the last meeting of the Company, the Chairman's speech reduced the seam from a reputed thickness of eight feet to forty-two inches, and he further suggested that a deeper boring might result in the discovery of petroleum; which every one knows possesses a commercial value, and the finding of which would quickly send the Channel Tunnel shares to a premium, a consummation not very likely to be reached by the original undertaking. But was this not rather a bac down from the coal discovery report? Mineral oils and true coal are not usually *en rapport*, although in Scotland, where the strata are much broken up, they are, we believe, found in the same district. Possibly we shall know more soon. In the meantime we offer our readers, for what they are worth, the following geological gleanings of the work in progress. At 408 feet from the surface, down to 477 feet, the Gault was being pierced; another hundred feet found the drill in the Hastings beds of the Weald; Purbeck limestone at 638, and Kimmeridge clay at 785. The first and second beds of shale having been passed in the carboniferous at 1200 feet, the so-called coal was found about 40 feet lower, and our informant saw a specimen, which had every appearance of being a *coaly lignite*, of doubtful value otherwise than as the Chairman of the Company has prognosticated.

Albino Rook.—Whilst rook-shooting at Walter's Hall, Monkton, Mr. George Collett killed a bird which he thought was a pigeon, but which, in reality, turned out to be a "white" rook. The plumage of the bird is perfectly white; it has a yellow beak, pale primrose legs, and eyes of

the colour of those of a ferret. It is stated that such a bird has not been seen or shot in Thanet for many years.—*Extracted.*

Varieties of Lepidoptera.—At the March Meeting of the Dover Field Club and Natural History Society, the President exhibited specimens of the common peacock butterfly (Vanessa Io) to show a gradation from the normal type to the variety known as the blind peacock. The latter insect owes its name to the blurred appearance of the eye-like spot, which gives to this butterfly its English title. In the first of the specimens, the eyes on the hind wings were of an intense black hue, totally unrelieved by the usual blue scales. In the second, the black itself was partly wanting, a couple of spots within the paler circle alone remaining to point out the situation; whilst in the third specimen, these too were absent, and the opalescent white had been replaced by a uniform duskiness.

Distorted Bloom of Foxglove.—On October 14th, 1889, at the Monthly Meeting of the East Kent Natural History Society, Mr. James Reid shewed a bloom of foxglove, from Mr. J. W. Newham, in which the axial bud growth had developed into one large petaloid growth of bell-shaped form, the calyx being multiple, and partly petaloid in its division. A few stamens appeared within the bell, but the development of seed vessel and contents, was represented by a confused mass of sepals and petals in narrow segments.

EAST KENT

Natural History Society,

6, High Street, Canterbury.

President—Mr. Sidney Harvey, F.I.C., F.C.S.

Hon. Treasurer and Librarian—Colonel Horsley, R.E.

Hon. Secretary—Mr. W. E. Drake, Victoria Road, Canterbury.

SUMMER EXCURSIONS, 1890.

May 15th—

Penny Pot Woods.

May 21st—

Barham, to meet the Dover Society, for the Annual Meeting of the conjoint Societies, relative to the General Council of the same.

June 7th—

Ham Ponds & Sandwich, in conjunction with the Dover Society.

June 12th—

Thorndean and Blean Woods.

July 10th—

Barham, and Wootton or Elham.

August 14th—

Sand Hills and Salt Pans, Sandwich.

September 10th—

St. Augustine's Monastery and Reed Pond, and Microscopical Meeting in the Evening, conjointly with the Dover Society.

DOVER FIELD CLUB

AND

Natural History Society.

President—SYDNEY WEBB, Esq.

Vice-Presidents—CAPTAIN McDAKIN. MR. RICHARD KERR.

Treasurer—MR. C. A. GRIMES.

Hon. Secretary—MR. EDWARD HORSNAILL.

Summer Programme, 1890.

Wednesday, May 21st—

Barham, Breach Down, and Denton, *via* Elham Valley; to meet the East Kent Natural History Society. Orchises, &c. Walking distance in all about five miles

Saturday, June 7th—

Ham Ponds & Sandwich. Botany, Pond Life, &c. About four miles.

Wednesday, June 18th—

Sandling and Lympne. Botany and Geology. About five miles.

Saturday, July 5th (low-tide)—

The Warren and East Wear Bay. Geology, Botany, & Marine Life.

Wednesday, July 23rd—

Woolwich Wood and Broom Park. Entomology and Botany. By waggonette.

Wednesday, August 13th—

Shottenden Wood, *via* Selling. Geology and Botany. About four miles.

Wednesday, August 27th—

Deal Sandhills and Marshes. Botany and Pond Life.

Wednesday, September 10th—

Canterbury—St. Augustine's and the Reed Pond. Microscopical Meeting in the Evening at the E.K. Society's Rooms.

VOL. I. PART II.

THE

South Eastern Naturalist.

THE TRANSACTIONS

OF THE

Associated Natural History Societies

OF THE

SOUTH EAST OF ENGLAND.

PAPERS AND NOTES

BY THE MEMBERS OF THE

East Kent Natural History Society and of the Dover Field Club.

Canterbury:

GIBBS AND SONS, PRINTERS, 43, PALACE STREET.

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CONTENTS.

TRANSACTIONS.

VIII.

THE HISTORY OF AN EAR OF WHEAT.

Abstract of a Popular Lecture

GIVEN BY

MR. G. DOWKER, F.G.S.,

OCT. 14, 1889.

In this Lecture Mr. Dowker first drew attention to the antiquity of the Wheat plant, remarking that, as there is no natural grass exactly corresponding to it, it must therefore have been produced by long cultivation and selection. He then gave a botanical description of an ear of wheat and particularized its component parts.

The contents of a single grain were then examined and explained with reference to the contained embryo and the starch and albumen by which it was surrounded. The chemical composition of starch was explained, and its conversion into gluten and sugar was shown to be due to the germination of the embryo; the malting process was also described. The growth of the radicle downwards and the plumule upwards were shown to be due in the first instance to the absorption of the nutriment contained within the grain, and the process was likened to the growth of the chick in the egg. Next, attention was drawn to the power inherent in the grain to remain dormant for a long period, if kept excluded from atmospheric agencies; but the lecturer gave no credence to those fabulous stories of wheat germinating after being embalmed many centuries with the mummies.* But it was likewise shown that when once the germinal process had started, it could not be arrested or retarded without great danger of death to the vital principle. Hence how important it was, not only that the wheat grain should have heat and moisture necessary for starting it into growth, but it was further essential these should continue till the radicle found its way down into the soil.

Allusion was made to the interesting observations of Dr. Darwin on the curions way in which the plant pushes its radicle into the soil, feeling

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* The story of the mummy wheat and its reputed growth has been often told. The fraud was exposed years ago, and the tale is quite repudiated now. [EDS.]

its way as it were for moisture by a rotary motion which he termed circumnutation, and how the hairs of the root adhere to the particles of soil and draw their nourishment from it.

It was also shown how at the same time the plumule pushes its way to the surface, exhibiting by its single leaf its characteristic class as a Monocotyledonous plant. The lecturer then explained the chemical action of the leaf whereby the green chlorophyl of the leaves decomposes the carbonic acid, fixing the carbon, and giving off the oxygen, this carbon being a particular plant product with which the greater part of its structure is built.

It was shown that the nutriment the plant derives from the ground can only be taken up by the plant in a soluble form, hence the value of a proper exposure of the soil to the action of the atmosphere was a necessary work for the agriculturalist, as well as the necessity for a proper supply of moisture. The part played by the rootlets in absorbing the proper nutriment was shown from the recent observations of botanists, to be due to the power they possess of decomposing the salts of the earth, by which the latter become available for the plant's use. It was shown by analysis, what salts the wheat plant derives. from the soil, but in what way its power of selection is made is a point Physiologists have not yet determined.

By the aid of a series of diagrams it was explained that the plant is built up of a series of cells having powers of reproduction, and that each parent cell gives rise to other cells of the same kind, each with its own proper function. Each cell of the plant has a vital chemical and physical action, and the lecturer observed that the action of these may be compared to the division of labor in a hive of bees, one set building up one part, and the other set building up other parts of the structure, one set feeding another set with their proper nourishment, and storing up starch for future use, as the bees do their honey. The connection between the roots buried in the soil and the leaves exposed to the air was explained by the action of osmosis and transpiration. By osmosis—in the absorption of the more fluid contents of the lower cells, through the cell walls, into the upper cells which are rendered more dense, and by the transpiration of water by the leaves, the whole being a diffusion of fluids controlled in some way by its taking place in a living apparatus. It was further explained that different parts of the plant have different chemical constituents, for example an analysis of the wheat and the wheat straw would show they were not of like constituents, for 100 lbs. weight of the wheat possessed about 30 lbs. of potash and soda, while 100 lbs. of straw possessed only 11 lbs.; and the wheat would have only 1 lb. of silica, while the straw had 66 lbs. It was stated that the contents of the plant cells called protoplasm is the seat of active chemical process and vital activity, which collectively are now termed metabolism. In the wheat grain is contained special chemical constituents termed albuminoids, similar in composition to the white of

an egg (which is rich in nitrogen), but the plant being unable to obtain its nitrogen from the atmosphere, obtains it from ammonia, *i.e.*, from hydrogen and nitrogen in combination—and such substances are found in organic matter. Part of the structure of the plant, it was shown, is built up from the in-organic particles of the soil; manure supplies the organic want of the plant in the form of nitrogen, also the in-organic elements in a soluble state. These in-organic elements in the plant are left in the ash when the plant is burnt, the organic on the other hand are consumed.

Mr. Dowker, said he wished to place the complicated phenomena of plant structure in a popular way before his audience; and in reference to the organic substances which were known as plant products, such as cellulose, starch, sugar, gum, plant gelatine, he explained that they were all composed of the elements, carbon, hydrogen, and oxygen, and in chemical language were expressed by a formula, C_{12}, H_{10}, O_{10}; and that these substances can be converted one into the other by varying the proportions. He compared the difference roughly to three dice which may be shuffled in a box and come out six, three, or two, as it may happen. In the plant the proportion of each was regulated by the protoplasmic contents of each cell, in a wonderful way which we cannot comprehend.

The structure of the wheat straw and leaf was next shown; and the tubular form of the straw, strengthened as it was by a deposition of silica, instanced as a wonderful provision of nature to secure the greatest strength combined with the least expenditure of material. Having dwelt upon the additions to the plant during its growth, Mr. Dowker next drew attention to its maturity and provision for the continuance of the species by the formation of seed.

As summer advances heat and light increase, and a corresponding impetus being given to the plant its energies are now directed into a different channel. Instead of leaves the ear is produced, and in it the ovule or ovary and the stamens. These stamens have three filaments, and the anthers are provided with fructifying pollen. In some plants provision is made for cross fertilization by insect agency, but in the wheat this is effected by the wind, which blowing across the field causes those undulatory motions we call waves of the corn, and the action transfers the pollen of one plant to the ovary of another. It was pointed out how important it was for the wheat crop that it should have a fine time for blooming, that this dusty pollen might be thus distributed. Up to this time the plant's energies have been drawn towards the growing parts, and stores of plant material, chiefly starch, have been deposited in the matured tissues. The stimulus of the growing shoots too have been the means of drawing its growth in that direction. Now a new stimulus is applied, while the other remains dormant. This new action causes the absorption of the nutriment hitherto bestowed upon the stem and leaves, and re-distributes it in the maturing grains.

This is aided by the summer's increase of heat about harvest time. It was shown that if uncongenial weather prevailed, such as wind and wet, not only was the wheat stem often bent, preventing this transfer of suitable material to the grain, but that the root threw up fresh leaves and stems, being stimulated to fresh growth by the rain, and thus the stimulus to the upper parts of the stem is withdrawn to the great detriment of the crop.

The lecture was illustrated by means of diagrams and specimens, and the best and latest authorities had been consulted in its compilation. Especial reference was made to the lectures on the physiology of plants by Mr. S. H. Vines, publishel by the Cambridge University Press; and a letter touching the matter of this lecture, which Mr. Dowker had received from Mr. Vines, was read.

IX.

THE STRUCTURE AND GROWTH OF SHELL IN THE MOLLUSCA.

Abstract of Paper

READ BY

MR. SIBERT SAUNDERS,

APRIL 14th, 1890.

The lecturer first pointed out the intimate connection which is found to exist between the shell and the branchiæ or gills of the mollusca. Shell in its simplest form exists in the common slug, and also in the Tectibranchiate marine molluscs as a thin calcareous shield embedded in the flesh of the animal, serving as a protection to the branchiæ; while in those cases where it forms a strong and solid covering, enclosing the entire animal (whether bivalve or univalve), it is still intimately connected with the breathing organ, the shell being in all cases formed by the mantle, of which the gills are a specialised part. The two-fold function of the mantle, in first, extending the margin of the shell by applying to its edge fresh deposits of shell-tissue derived from its own substance, and then in lining the whole interior with a different kind of calcareous matter, deposited from its surface, was then referred to, and the various kinds of shells were described. The internal lining found in most shells presents a surface of perfect smoothness, and sometimes has a high polish. This is said to be sub-nacreous, it not having the irridescent lustre of the true nacre, which is found only in a few families. The pearly irridescence of true nacre is produced by the light falling on the outcropping edges of partially transparent plates forming wavy lines on the surface of the shell. This striation is effected by the folding or

plication of the animal membrane deposited by the mantle, by which the nacre is secreted. The folds, lying more or less obliquely to the general surface, and being arranged with considerable regularity, cause the diffraction of light upon which the irridescence depends. Similar folds of basement-membrane exist in sub-nacreous shells, but the arrangement of the lines lacking regularity, no pearly lustre is produced on the surface.

Living shells are covered with an outer coat of animal matter—the epidermis or periostracum. In some cases this is so thin and transparent as to be scarcely perceptible. In others it is a dense horny skin. Sometimes it takes the form of a silky woven material. It serves to protect the shell against the erosion of chemical agents. Its appearance during the life of the animal is very different from that which it presents in "dead" shells, where it soon shrivels up and peels off. Like the outer layer of shell, the periostracum is formed by the glandular margin of the mantle. Some of the glands contained in the thickened margin of the mantle secrete colouring matter. The pigment so furnished is mixed with the calcareous additions made to the edge of the shell, and thus the outside of the shell becomes painted with coloured spots or lines, which vary in different species according to the position of the colour glands, and also according to the intervals between the periodical secretion of colour. The spines, plates, and ridges, seen in many shells are produced by the periodical protrusion of certain portions of the edge of the mantle. The spines thus secreted may be separated from the next row by a considerable space, owing to the intermediate deposition of a greater or less amount of shell substance presenting a plain or rigid surface. Some remarkable examples of the repair of broken shells and the modification of form, where necessary, were described and illustrated by specimens. Examples of all the kinds of shell referred to in the paper were exhibited, and the cellular and prismatic structures demonstrated by the microscope.

X.

SANDPIPES.

Abstract of Paper

BY

MR. ARTHUR S. REID, M.A., F.G.S.

Read before E. K. N. S., MONDAY, APRIL 13th, 1891.

The Author having pointed out the frequent occurrence of sandpipes in limestone districts, alluded especially to those of the North and South Downs; he then gave a description of the gradual formation of a sandpipe

by the action of carbonated water, and of the slow subsidence of superincumbent strata into the pipe, illustrating his remarks by coloured diagrams and enlarged photographs taken by himself in this district. Professor Prestwich's theory to account for the greater proportionate increase in length than in breadth of a sandpipe was detailed, and the Author suggested a possible method by which "fissure-pipes," as he termed them, might be formed, and he exhibited enlarged photographs of the Lenham pipes in view of his suggestion. After contrasting the formation and structure of sandpipes with those of swallow-holes, the Author went on to point out the geological value of sandpipes as often preserving remnants of strata, the principal parts of which have been removed by denudation. Passing to the special case of the classical Lenham pipes he detailed the controversy which had taken place over the age of the strata preserved in these pipes, and described their appearance and contents at his many visits; specimens of the fossiliferous ironstone were exhibited, and lists of the species determined from casts by Messrs. Searles Wood, Clement Reid, &c., were given. The Author then described the Diestian beds of Antwerp, and after pointing out the various interesting problems which arose if these Lenham beds were early Pliocene or of Mio-pliocene (Diestian) age, he concluded that, whereas it seemed fairly well settled that the fauna of the Lenham sandstones must be classified as of early Pliocene or of Miocene age, it did not at all follow that all the un-fossiliferous sands and sandstones of doubtful age which occur in patches on the Downs are to be so classified; but that in all probability some of them were of Eocene while others were of Mio-pliocene age.

XI.

OUR BATS.

Abstract of Paper

READ BY

MR. GEORGE DOWKER, F.G.S.,

NOVEMBER 19, 1890.

Mr. Dowker, in this paper, furnished some observations he had made during the past few years upon the habits of the different species of Bats he had met with at Stourmouth and neighbourhood.

He prefaced his remarks by giving some anatomical peculiarities of the British Cheiroptera, more especially referring to the great development of the digits; comparing the bones of the Bat's wing with those of birds and the pterodactyles, and their skulls with those of the Insectivora;

and further remarked upon the extraordinary development of the appendages and ears, and likewise of the nose in some species.

It was observed that Bats, being nocturnal in their habits, appeared to be furnished with especial auditory organs for the purpose of finding their food in the dark, and the *tragus* seemed to possess its large development for the purpose of localizing the position of the insects on the wing on which they usually fed—while the special olfactory organs are adapted for a similar use. Spallanzgni's experiments were quoted to prove their powers of avoiding obstacles in the dark, while it was remarked how difficult it was to catch a Bat upon the wing.

The Bat's squeak was likened to the grating of a sharp file, or the friction of iron wheels; it is a note of very high pitch, which some people cannot hear.

Illustrations were exhibited of the "Large Horse Shoe Bat," the "Long-eared Bat," the "Serotine Bat," the "Vampire" and "Noctule."

Mr. Dowker recounted his observations on the period of hibernation and migration of some of the species he had met with in his immediate neighbourhood, observing that some species come out in winter occasionally, and also by daylight; whilst others only appear at set times in the year, and come out at regular hours of the evening. He observed, with respect to the Noctule (one of our largest Bats), *Vesperugo noctula*, that it frequented hollow trees and houses. In April, 1884, several of these Bats were turned out from the rotten branch of a walnut tree, where they had been hibernating; all were males, and each measured 14in. in the expanse of its wings; they had a strong disagreeable smell (common to the species), and although they were captured alive they soon died after being kept in a cage, for they refused all food.

A large number of this species, however, Mr. Dowker had noticed to hibernate in his house. They found their way into the top gable and apparently lodged in the wooden brackets and mouldings. He observed every summer that these emerged from their winter quarters about the middle of May; and regularly took flight at eight o'clock in the evening, and that they continued to frequent the house till the first week in June, when they would all migrate, and not appear again till the following September. It was observed that they fly very quickly, and very high, dispersing to long distances over the marshes immediately on leaving the house. For instance, on May 17, 1889, he observed fifty-six Noctule Bats emerge from their winter quarters precisely at eight o'clock in the evening, in quick succession one after the other. They flew away to the marshes and were soon all lost to sight, and although he walked some distance after them not one was seen on the wing. On the following evening at the same time some forty were counted, and three of them were shot as they flew away. These were all females, and each of them measured 14in. from tip to tip of their expanded wings. After

dispersing, the bats reappeared near the house in September. The same thing happened in 1882, and again in September, 1887—after absence from the previous May and June.

The following notes were referred to by Mr. Dowker, taken from his memoranda, as proving the regularity of their appearance, viz. :—

May 21, 1890.—Counted seventy-eight Bats emerge from the house at 8 p.m., returning to their dormitories at 9 p.m. May 23.—One hundred and sixty Bats from the house at 8 p.m. May 26.—One hundred and seventy eight Bats at 8 p.m., and twenty-seven more at 8.15 p.m.

After disappearing from the house in June a few were noticed to hang about some elm trees in the parish towards night, as if they took to them for rest by day, but finally they entirely left the neighbourhood. The entire disappearance of the Bats from June till September could only be accounted for on the supposition that they migrated.

Mr. Dowker quoted several notices of the migration of the Noctule, recorded in the *Zoologist*—especially one by Mr. Wm. Jeffery, in Sussex, who noted a great increase in the number of the Noctules in August, and he supposed they were moving southward then. And Mr. A. J. Clark Kennedy observed, about 5th of May, a flight of large Bats going steadily in a north-easterly direction at Little Glenham, in Suffolk.

The interesting account of the habits of the Noctule Bat, published in the proceedings of the Zoologist Society, by Mr. Daniel, in 1834, in reference to their growth and reproduction, was likewise quoted.

Mr. Dowker recorded his observations on the "Long-eared Bat" *(Plecotus auritus)*, mentioning that multitudes of this species hibernated in an old farm house at Knowlton Court, where they even hung from the rafters in clusters; so much so, that he hived a number in his hat like a swarm of bees. On one occasion, seeing two of these bats flying about his room, he captured them and placed them under a bell glass for future observation; next day, to his surprise, he found four instead of two under the glass, but they were all dead. On examination it appeared there were two female Bats and two young ones; the latter had evidently adhered to their parents by the nipples of their teats. On measuring their expanse of wings it was found that the mature bats measured ten inches, while the young measured eight, so there was no great difference in their size. The ears of the young ones were doubled back. This species of Bat is common in Kent.

Vesperugo serotinus, a Bat which exceeds in size the Noctule, was the next species described. It was said to be tolerably abundant at Stourmouth. It probably frequents hollow trees. In a note on this Bat in the *Zoologist*, 1887, it is stated on the authority of Lord Lifford that it

flies very high, and is very fast on the wing, but Mr. Dowker's observations would prove the reverse, as it flies oftimes near the ground about trees and passes along lanes low enough to be struck with a coachman's whip. It does not migrate like the Noctules, and is rather late in spring and autumn on the wing.

The following Bats, which are met with in Kent, Mr. Dowker had but slight acquaintance with, except the common *Vesperugo pipistrellus*, which small Bat is met with everywhere, and is to be seen on the wing at all times of the year.

Vespertilio mystacinus, which is a Bat about the size of *pipistrellus*, is recorded from Kent, and is probably often mistaken for the latter.

Natterer's Bat (*Vespertilio Nattereri*) has been recorded from Tunbridge and Chislehurst.

Daubenton's Bat (*Vespertilio Daubentonii*) is recorded from Dover, and Mr. Dowker believes he has seen it on the wing in his neighbourhood.

The greater Horse-shoe Bat is recorded from Kent, especially from Canterbury Cathedral.

In conclusion, Mr. Dowker observed that most of the British Bats have been found in the County, but the subject has received but little attention from Kent Naturalists, and we may expect more information from further observations.

References to Bell's *British Quadrupeds*, and the volumes of the *Zoologist* were quoted by the author, the Bats having lately occupied much attention and observation, especially at the hands of the Editor of the *Zoologist*.

The following is a list of the Bats in Kent observed by the author, or recorded by others:—

Vesperugo noctula.
,, *pipistrellus.*
,, *serotinus.*
Vespertilio Nattereri.
,, *Daubentonii.*
,, *Mystacinus.*
Plecotus auritus.
Rhinolophus ferrum-equinum.

XII.

CONCRETIONS AND CONCRETIONARY ACTIONS.

Abstract of Paper

BY

MR. ARTHUR S. REID, M.A., F.G.S.

Read before the East Kent Natural History Society, JANUARY 13th, 1889.

The Author having distinguished between Concretions and Secretions, divided the former into two classes: (1) those which have been formed more or less contemporaneously with the beds in which they are found: (2) those which have been formed subsequently to consolidation, by segregation from the surrounding rock.

In considering the forces at work to bring about concretionary action, the Author described the probable way in which the phosphatic nodules of the "Cambridge Greensand" were formed; then passing to concretions formed subsequently to consolidation, and in which there was no trace of an organic "irritant," he pointed out the tendency of particles of a mineral diffused in small quantities throughout a rock mass to congregate towards definite points; and discussed other similar molecular actions especially in relation to "diffusion currents."

The Author then described and exhibited specimens of the more important forms of concretions; peroxide of manganese concretions of the deep sea were described,—and the probable origin of chalk flints was pointed out. The solubility of organic silica in carbonated water, and the replacement of carbonate of lime by silica was demonstrated by the "green coated" flints of the Thanet-bed, resting on tabular chalky flints now seen at the top of the chalk. The origin and structure of the London Clay septaria was described, and specimens of iron-sand concretions from the Old Red Sandstone of Scotland were exhibited, some of these shewing a concretion in the process of making. The "half-hearted attempts" of calcium sulphate to crystallize out in the Oldhaven sandy beds, was contrasted with its more successful attempts in the finely divided London Clay. Some remarkably globular concretions from the fine sand of the Folkestone bed at Hothfield were exhibited and described. The formation of marcasite concretions in the chalk, &c., was fully discussed, and the fantastic shapes assumed by the "*Löess-puppen*," "*Imatrasteine*," and "*Fairy stones*," touched upon, as also was "cone-in-cone" structure. Finally, in relation to the symmetrical shapes assumed by some concretions, it was pointed out that this might often be accounted for by the greater freedom for molecular movements in rocks that were perfectly homogeneous.

The paper was illustrated by diagrams and specimens of concretions collected by the Author.

XIII.

SHELLS AND SHELL COLLECTING.

Abstract of Paper

BY

MR. S. B. COX, B.A.

After describing the anatomy of the Mollusca and the formation of the shell and alluding to the food of certain species, Mr. Cox gave an account of a supposed ramble in search of shells in the neighbourhood of Canterbury, commencing in the lane above Fordwich and passing through the woods into the marshes,—the collector might hope to find most of the following:—

HELICIDÆ.

Vitrina pellucida. Common; especially about December, in woods on fallen leaves; Trinity Park, &c.

Zonites cellarius. Common; of a large size in conservatory at Fordwich.

Zonites glaber. Common in lanes above Fordwich.

Zonites nitidulus. In lanes above Fordwich.

Zonites crystallinus. Common in the woods round Fordwich; under rotten damp logs of wood, and leaves.

Helix aculeata. In Wood lane, Fordwich; on the old wall of the former park of Lord Cooper; above Wood lane, Fordwich.

Helix aspersa. Everywhere.

Helix nemoralis. Small; not common round Fordwich, in the lanes, more numerous round Dover.

Helix hortensis. Common; many varieties in the lanes; a good shelter in winter and dry weather is secured by heaps of refuse hedge clippings, hop bine, &c., so often by the side of country roads.

Helix hybrida. Fairly common in the lanes round Fordwich.

Helix arbustorum. Common in the road to Dover, just beyond Kerswell Station, after rain. This is a local species.

Helix cantiana. Common in the lanes. In profusion on the cliffs at Dover, where an almost pure white variety is fairly common.

Helix cartusiana? Sandwich.

Helix rufescens. Common in the lanes and hedges.

Helix hispida. Common in hedgerows.

Helix sericea. At Chartham in a hedgerow.

Helix virgata. Common on the chalk hills of Dover, probably at Chartham and neighbourhood; but I have not hunted there; rare round Fordwich, and very small.

Helix caperata. Living with the last species.

Helix ericetorum. Common and fine at Dover on the chalk hills, particularly so near the Convict Prison.

Helix rotundata. Common in damp places under stones, bricks, wood, &c.

Helix pygmæa. Under damp logs of wood, in company with Zonites crystallinus, in the lanes and woods above Fordwich.

Helix pulchella. Not common round Fordwich. In the same situation as the last species.

Helix lapicida. Numerous on the old wall before mentioned above Wood lane, Fordwich; after wet, or in the early morning.

Bulimus obscurus. In the spring and autumn; on their way up the trees where they generally pass the summer. In Wood lane.

Pupa umbilicata. On every old wall, between the bricks, where overgrown with ivy.

Pupa marginata. On the same wall as Helix lapicida.

Vertigo substriata. Marshes below Fordwich; by the sides of the dikes, at the roots of grass, or crawling up the blades.

Clausilia rugosa. Common on old walls and in woods; in the moss which much affects the lower portion of the trunks of Ash trees,—a fertile hunting ground for many species.

Clausilia Rolphii. In the lanes above Fordwich.

Clausilia laminata. On Ash trees, in the woods above Fordwich.

Cochlicopa lubrica. Common at the roots of grass, &c.; Fordwich and most places.

Achatina acicula. This is an underground species. Rare, or at least hard to find; two specimens below fallen bricks from the old wall at the top of Wood lane, Fordwich.

CARYCHIIDÆ.

Carychium minimum. With Zonites crystallinus; under rotten and damp wood, &c., and fallen leaves.

CYCLOSTOMATIDÆ.

Cyclostoma elegans. Common at Dover, and probably at Chartham, or wherever the chalk appears; not at Fordwich, or apparently on that side of Canterbury.

FRESH WATER SHELLS.

SPHŒRIIDÆ.	*LAMELLIBRANCHIATA.*	
Sphærium corneum.	In the marshes below Fordwich.	
Sphærium rivicola.	Ditto	ditto.
Pisidium amnicum.	Ditto	ditto.
Pisidium fontinale.	Ditto	ditto.
PALUDINIDÆ.	*GASTEROPODA.*	
Bythinia tentaculata.	Ditto	ditto.
Bythinia Leachii.	Ditto	ditto.

VALVATIDÆ.

Valvata piscinalis.	Ditto	ditto.
Valvata cristata.	Ditto	ditto.

LIMNÆIDÆ.

Planorbis spirorbis.	Ditto	ditto.
Planorbis vortex.	Ditto	ditto.
Planorbis carinatus.	Ditto	ditto.
Planorbis complanatus.	Ditto	ditto.
Planorbis corneus.	Ditto	ditto.

Planorbis contortus. Ditto ditto. Scarce ; probably lower down the marshes they may be more numerous.

Planorbis nitidus. Apparently uncommon, in the marshes below Fordwich.

Physa fontinalis. Common, Ditto ditto.

Limnæa glutinosa. Local, Ditto ditto. One dike was crowded with the species in a summer some years back ; two years later it was apparently not there. The usual history of this curious species.

Limnæa peregra. Common everywhere.

Limnæa auricularia. Noticed in the river above the paper mills, Chartham, where a few were secured.

Limnæa stagnalis. Fordwich marshes.

Limnæa palustris. Not common in Fordwich marshes.

Ancylus fluviatilis. In the Stour at Chartham and Thanington, adhering to stones at the bottom of the river.

XIV.

A SHORT ACCOUNT OF SOME BONES AND TEETH FOUND IN THE VALLEY DRIFT OF THE RIVER STOUR NEAR CANTERBURY.

BY

MR. J. REID, F.R.C.S. Eng.

The drift deposit, here alluded to, lies on the southern slope of the Stour valley, resting on the eroded surface of the chalk ; the particular portion referred to extends from the W. of Canterbury near the Waterworks, to the L. C. D. Railway Station on the East limit, and is situated immediately behind the South side of Wincheap Street. The depth of

the deposit from W. to E. varies from 12 ft. to 23 ft., and is covered by a similarly varying capping of brick-earth, which is thickest at the E. end. The greater mass of the deposit is made up of a mixture of boulder-flints, coarse and fine gravels, with sand and loamy patches; generally, the finer materials are in the middle and upper levels. The greater part of this portion of the drift has been excavated, and carried away during the past 20 years, for the sake of the gravel and flints it contains, and from time to time teeth and fragments of bones of the extinct Elephant, or Mammoth, have been found and locally identified. The full amount of these and other remains of animals found are unknown, owing to the high prices obtained by the workmen from isolated naturalists or the London buyers of such objects. Many evidences of the derived rock-remains, with a few fossils as oyster shells and wood bored by molluscs, belonging to the Beds above and below the chalk have been found in the gravels and sand-patches.

In the Autumn of 1890 fresh ground was opened in the East end of the deposit under the part known as the "Martyrs' Field," and from time to time the following specimens have been obtained, and their position verified:—

(*a.*) Upper cervical vertebra of the Mammoth, found at 18 ft. below the surface; in a cone of fine gravel with rounded and rather small pebbles.

The vertebra was oblong laterally in its body, which had a large portion detached from its neck-side to the left of the middle* line, the surface and edges of the body were much worn by friction on this side, the right being better defined. The two dorsal processes had been knocked off, only the broad knob of the left one remained, and the right one was split into two portions with some loss of substance at its base and dorsal end.

(*b.*) A fossilized oyster-shell resembling those found in the Woolwich beds, in a thin pocket of sandy deposit 4 ft. above (*a*).

(*c.*) A fragment of a Mammoth-tooth, including some of the posterior undeveloped plates and basal portions of five plates in front of them. This was in a similar matrix to that in which (*a.*) was found, about 3 ft. N. of it.

(*d.*) Fragments of a molar-tooth of Rhinoceros ticorrhinus, shivered to pieces by the pick-axe. They consisted of an outer portion of the crown with three grooves, three cusps, and a fragment of the inner duplication of the bone attached; three portions of the inner duplications of the outer wall; parts of two

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* The position and aspects of the part are described as if *in situ* in the full form of the body of the animal as it would stand.

fangs and other portions of cusps and cementing material; depth 14 ft. or 15 ft. from the surface and several yards N.E. of (*a*).

(*e.*) Metacarpal Bone:—This was identified as belonging to *Equus caballus*, and was found near the tooth (*d.*); it was also thought to belong to a young animal, from the even and entire manner in which the three portions of the epiphysis had separated from the fractured end of the shaft, to the united fragments of which it accurately fitted. The bone was heavy and partially silicified, and was covered with a thick whitish crust mixed with sand-grains.

The specimen was found about 14 ft. from the surface, two or three yards S.E. of the tooth (*d*).

(*f.*) Portions of two Mammoth-Teeth, *one* shewing nine of the posterior plates, which were coarser, and less finely plicated in the enamel than the other specimens, the plates also were somewhat curved, less parallel and further apart. These variations may be due to the fragment being from the base of a tooth. The *other* fragment had ten plates which were longer and presented the ordinary appearance of the other teeth met with, being parallel, close fitting, with the enamel finely plicated along the sides. These were found on a line N. of (*a.*) at a distance of several yards in the fine gravel.

(*g.*) A fragment of a Molar Tooth of a Mammoth shewing three of the shallow irregularly folded posterior plates with eight closely fitted parallel plates in front, the foremost one being 3"½ long by 2" wide, near this were found some 15 fragments of a large bone, the outer surface of many of these presenting characters resembling those of a tusk,* in the denseness, smoothness, and striated condition of the surface; three of these fragments were 5 and 4 inches long by 2 or 1 inches wide, and could be sufficiently fitted so as to show a longitudinal as well as a horizontal curve. These were found on a line with (*a.*) and (*f.*) and near the latter.

The workmen reported some traces of ribs in thin layers of bluish grey clay, they were long greyish bodies which fell to pieces when touched, the fragments having a resemblance to the texture of bone.

(*h.*) A portion of silicified wood 4"½ by 2"½, but of irregular thickness, from the outside of an exogenous tree, having two holes and several grooves within, formed by the boring of molluscs. This was found in the fine gravel, and was probably derived from the Woolwich bed above the chalk.

* Two portions of the distal extremity of tusks about 20 in. long were subsequently found, but were too much disorganised to permit of removal.

XV.

ON THE INTERNAL HEAT OF THE EARTH, AND SOME REMARKS UPON VOLCANOES.

Abstract of Papers

READ BY

CAPTAIN McDAKIN,

13th May and 9th December, 1889.

After reviewing the several theories respecting the internal heat of the earth, it was suggested that this must, in part at least, be due to the oxidation of organic matter, as shown by the large amount of carbonic acid gas contained in spring water, as well as the large volumes of nitrogen given off by the same, the air absorbed and carried down by rain water, causing a slow combustion with organic matter washed out of the surface soil.

The King's Well at Bath, which gives off in contained gases, 96 per cent. of nitrogen, was mentioned in illustration, also the Bristol Hot Wells, 92 per cent., and Taafe's Well, Cardiff, 96 per cent. Now water absorbs one measure of oxygen to two of nitrogen. "With these effects in view," the lecturer continued, "I took some garden mould and a one per cent. solution of permanganate of potash, allowing both to remain in the same room for twenty-four hours, so that they might be of the same temperature. I watered the mould with the solution. On placing a thermometer in the earth so watered it rose two degrees in a few minutes, showing the oxidation of organic matter had produced heat." The question was then asked:—"May we not have, both in the sun and the earth, a circulation of elementary matter in the solid or surface portion of the crust, where under immense pressure, associations, and dissociations take place, renewing the internal heat by chemical action and the force of gravity?" For as in the animal and vegetable we should not have the development of heat without vitality; so in the earth we should not have the same amount of heat as now exists without gravity—the vital force of the earth, plants and animals, and our laboratory experiments, all alike being subject to the same universal law. The circulation of water may possibly be the vehicle of action with our globe, but until we know of what particular component parts the atmosphere of the sun consists, we cannot of course speak positively for that luminary.

Drawing attention to the evidence of volcanic action in the south-east of England by the anticlinal of the Weald, and the London and Hampshire basins, with the cross flexures giving the initial direction to the rivers draining the Wealden area—the author described some of the

remarkable features of Fingal's cave, and the craigs of Edinburgh, and Stirling, which he termed fossil volcanoes of our own country, and the fissure flows, dykes, and prismatic traps of the West of Scotland, and North of England. The probable cause of volcanic action, is the association and dissociation taking place among the elements of the earth's interior, the conditions of which are similar to those now prevailing in the sun, but in a reduced stage of energy. The author concluded by remarking that the fair county of Kent was possibly preserved by Hecla on the north and Vesuvius on the south, acting as safety valves, by permitting immense volumes of steam to escape. This outpouring of watery vapour is the chief cause of the shrinkage and folding of the earth's crust, and of the great features of the globe.

An additional interest was given to this paper by an account of some personal experiences on the cone of Vesuvius and remarks on the flow of lava streams.

The papers were made attractive by numerous illustrative sketches and wall diagrams from the facile pencil of Mrs. McDakin.

XVI.

THE HERRING GULL. *(Larus Argentatus.)*

Abstract of Paper

BY

MR. GEORGE GRAY.

Read before the Dover Field Club, 17th MARCH, 1891.

The Herring Gull is the most widely distributed member of its family on the coasts of the British islands; breeding wherever precipitous cliffs, or isolated stacks of rocks afford suitable situations. It is not confined to our shores, however, but is abundant on the coasts of Scandinavia and the Baltic, whilst immense numbers occupy the low Frisian islands, especially Sylt, whence from forty thousand to fifty thousand eggs are taken for eating in a season. Southwards it ranges down the western seaboard of Europe, as far as the Azores. In the Mediterranean there is a resident sub-species (*Larus cachinans*, of Pallas) characterized by a darker mantle, lemon yellow legs and feet, and an orbital ring of a deep orange red. This form not only extends to the Black and Caspian Seas, but reaches northwards to Archangel, and still further eastward it frequents the shores of the Pacific.

But although of so wide a range, we may yet consider the Herring Gull as truly a Dover bird, for it is with us all the year round, and even

rears its young within a few hundred yards of the houses upon the sea front. Who has not watched the easy and graceful flight of this bird? now poised almost stationary in the air with outstretched wings; then with a few sharp flaps of them borne away at a tremendous rate of speed, yet without any apparent exertion, anon circling round with downward hung head scanning the waves from a great height for small particles upon the water or pouncing upon some little fish when it sees one near the surface. One can scarcely imagine the keenness of sight requisite for thus obtaining its sustenance, and when we watch these birds attentively we are further surprised to note that although provided with distinctly webbed feet and capable at pleasure of resting upon the water for the purpose of repose, yet a gull never voluntarily dives below the surface of the water. The English name of Herring Gull is then, in a great measure, a misnomer, for it is dependent either upon floating objects for its food, or else obtains it from the sea shore, or the neighbouring land, hence the large numbers which are seen at times following the plough. Nothing indeed seems to come amiss, whether land vermin or shore produce, and it is quite immaterial to the bird whether the flesh be live or dead, fresh or putrid. The author had on one hand seen quite a number surrounding and delighting in the bloated carcase of a dead and certainly not inoffensive dog; and on the other had known a sea gull to be fed exclusively upon a diet of maize. From their natural habits of life we may look upon the gulls as invaluable shore scavengers, for were it not for these birds our beaches would be sometimes strewn with decaying and offensive matter.

After describing in detail the appearance of the Herring Gull, and mentioning the fact that four years are required before the nestling assumes the colored plumage of the adult bird, the author said that during the winter months the birds were to be seen in all the intermediate stages, according to age, up to the white and dove-colored old birds, but as soon as these latter take to the cliffs for the purpose of breeding, the immature birds leave this part of the coast. It is surmised that they follow the shoals of fishes, and return again after the nesting is over.

The flesh of a Herring Gull was described as being coarse and rank, with a strong fishy flavor; Mr. Gray had tried various ways of cooking them without being able to overcome the bad taste, but he suggested that the taste might perhaps be improved if the bird, in a tame condition, were kept for a time entirely upon grain before being killed. The eggs are palatable, and, as before mentioned, held in some esteem, being little inferior to a tame duck's egg.

"As regards the nesting places upon the cliffs, these are both the narrow ledges or shelves, occasionally seen between and below the various beds of which the chalk consists, and also the sloping surfaces of the rock itself. To such situations the birds resort towards the end of April, when they assemble in vast flocks, and make the air resound with their peculiar and harsh cries. The cliffs between Dover and

St. Margaret's Bay appear to be great favorites, and sometimes in Spring there is scarcely an available spot between these places that has not a gull's nest upon it. I have counted upon a rock, not more than eight or nine feet square, as many as twenty five birds sitting. Some build a true nest, whilst others lay their eggs upon the pure chalk, or amongst the growing herbage, if any. They usually lay two or three eggs, which are of a light olive brown color, blotched and spotted with dark umber and black. When a nest is made it is usually constructed of dry grasses, and sea-weed, but I have seen pieces of rag or rope intermixed.

Gulls frequently lay their eggs at the bottom of the cliff, or even upon the beach without any nest or even signs of one; but those so easy of access are sure to be found and picked up, as many persons are on the watch for them.

The earliest date I have been able to find an egg has been the first of May, and the earliest young bird was upon the first of June, so I suppose the period of incubation is from three to four weeks, probably the latter.

I noticed a very large nest last season, neatly made and of a good shape, it stood more than a foot high, and was placed upon a sloping piece of rock, on which an egg could not possibly have remained if not retained by the materials brought together. Visiting the spot frequently, I remarked that there was always another gull sitting beside the nest. I startled the birds off, and upon each occasion of their return there was a desperate contest as to which of the two should be the incubator, the vanquished one then took up the position I had noticed to be occupied close by, and settled down there, apparently awaiting its opportunity to sit in turn upon the eggs when the other left. I could not see into the nest to ascertain the number of eggs, but I have no doubt that they were the eggs of both birds, and probably each had assisted in the building.

The nestling gull is very similar in coloration to the egg it has lately quitted, and may be easily overlooked by any one, even when directly opposite. Like young ducks they run about as soon as hatched and travel about the cliff where practicable, but this is not without danger, for they oftentimes lose their balance, and tumbling to the bottom are either wounded or killed by the fall, indeed, I have frequently, after a very strong wind, found young birds under the cliff, that had evidently met their death through having been blown off in the night.

There has lately been a very large fall of the cliff near the Cornhill Coast Guard station which has destroyed one of the best breeding grounds of the Herring Gull in this neighbourhood."

Large cases exemplifying life histories of the Herring Gull were exhibited, and stuffed specimens of the birds in all periods from the nestling to the adult.

EXHIBITS.

BUTTERFLIES OF THE MALAY PENINSULA,

BY

MAJOR GODFERY.

Major Godfery gave a rapid sketch of the five great families represented in the fauna of the Peninsula, with selected typical genera and species to illustrate his remarks. Instances were given of the discovery of new and rare butterflies in the Malay Peninsula, and the subsequent discovery of the same species in the island of Borneo and *vice versa*. The researches of Major Godfery resulted in the addition of some thirty species to the fauna, of which fourteen proved to be new to science. The principal butterflies new to science which he exhibited were: New genus and species, *Deramas livens;* New species, *Elymnias Godferyi*, *Charaxes Durnfordi*, *Ixias Birdi*, *Iraota Boswelliana*, *Tereas lacteola*, *Papilio caunus* (variety).—*E.K.N.H.S.*, *Jan.* 10*th*, 1889.

Forms Assumed by Spirogyra.—Captain McDakin exhibited, under the microscope, a mass of the water plant *Spirogyra*. A remarkable feature of the plant is the changes of form the mass undergoes in a few hours, such as a corkscrew, the letter C, the conventional serpent about to strike, the figure eight, a coiled serpent, and many cloud-like forms in which we might trace the resemblance of other things. Although some of these changes are due to evolved oxygen buoying up the mass, and to variations of atmospheric pressure and temperature, the form is influenced to a much greater extent by the electrical condition of the atmosphere. During a thunderstorm on a dull morning in April, with no sudden change in pressure, temperature, or light, the changes of form were comparatively rapid, three radical forms being assumed in five hours, with many intermediate gradations.

A New British Snail.—Captain McDakin exhibited some specimens of a Helix, found by Mrs. McDakin on the 25th October, 1890, in the neighbourhood of Shepherdswell, Dover. The first shell found was forwarded to Stanley Cox, Esq., of San Remo, Torquay, Devon, who identified it with the *Helix elegans* of Gmelin. The same species of snail has been found in S. Carolina, N. America. It has been hitherto unrecorded as occurring in Britain.—*E.K.N.H.S.*, *Dec.* 8, 1890.

Separation of Metallic Alloys.—Captain McDakin exhibited some blow pipe beads, showing, by Colonel Ross's process, the separation of alloys consisting of gold and silver, copper and silver, &c. The metals separate at a red heat below their fusing point; if the temperature is

raised till they melt, the alloy is reformed. This is an interesting example of a molecular change in a solid form.—*E.K.N.H.S.*, *Feb.* 21*st*, 1889.

Flint Implement.—On the occasion of Mr. Dowker's paper, entitled "Thoughts in a Gravel Pit", a Neolithic flint weapon was exhibited, which had recently been found when excavating for the foundations of an ordnance store near the Priory Station, Dover.

This object, now in the possession of Colonel Corrie-Walker, R.E., was found on the surface of the chalk under the rainwash of brick earth, amounting to about 3 feet 6 inches, and about 18 inches of vegetable soil. It was of grey mottled flint like the tabular flint of Pegwell Bay, about 8 inches long and 2½ at the broadest end, which was ground smooth.

D. F. C. and N. H. S., *Dec.* 19*th*, 1889.

Singular Pebble.—Mr. Sydney Webb exhibited an oval pebble from the beach at Southwold, with the view of shewing that silica in its various forms of flint, &c., must have been once in a mud-like condition. The exterior of the pebble, which has been polished over a portion of its surface, without cutting, is transparent chalcedony; but the remainder is unpolished, of a dull yellow color. Viewed from above the chalcedony (as a sheet of glass) shows this yellow portion to have contracted whilst soft; by this action broad cracks in its substance were formed, which later on were filled in and covered over by the superincumbent translucent material, with a very pleasing effect.—D.F.C.

Mr. Dowker supplements the description thus:—The pebble is the result of metamorphism, whereby a septarian concretion, which had, perhaps, the cracks filled originally with calc-spar now shews them covered by chalcedony. It is well known that in the "London Clay" concretions of nodular clay and limestone are abundant, but it is impossible to determine from what bed this specimen was derived in the first instance. Biller's spar and calc-spar are often replaced by silica; indeed, Bischof states that Biller's spar acts as the precipitate for silica. But the alteration of a mineral is an extremely slow process. It is accomplished in the wet way by water that holds certain substances in solution being brought into contact with the mineral, and the pseudomorphic process may be imagined to consist either in direct conversion of minute particles of the original mineral into the new substance, or in a series of intermediate changes, the results of which are minerals successively more distinct from the original in composition, and nearer to the final product. Crystalline and amorphous quartz are associated in petrifactions as well as in amethyst druses, the former occupying the interior, the latter the exterior. In many belemnites quartz and heavy spar are found as petrifying materials, so that the upper part of the sheath consists of quartz, and the lower part of sulphate of baryta. In this specimen

there is no intermediate stage. The matrix seems a clay ironstone, the right angled cracks show that the shrinking of the original nodule was in one plane, and the interstices were filled up before the pebble became rounded, for no extraneous matters excepting those that have been introduced by infiltration are apparent. The concentric mammillated structure shown in the opaque yellow portion of the specimen is due to metamorphic action, this is concealed in a great measure by the polish upon the other side, but it may be made out by looking with care.

Without analysis it is difficult to say exactly in what state the transparent silica occurs, but I should call it chalcedony, which is well known to be a silicious mineral of the quartz family, closely allied to opal and agate, and, with them, associated in geodes and vein bands. It is usually uncrystallized, of a milky white or pale yellow color, and often has a wavy internal structure and peculiar mammillated surface.

Perhaps the specimen was from some raised beach. If so its history would take us back through many geological changes.

NOTES.

Rare Plants.—The village of Shepherdswell, midway between Canterbury and Dover, has obtained quite a notoriety for rare botanical specimens. About six years ago a fine specimen of *Orchis hircina* was found on the border separating a hedge-row from a cultivated field. Unfortunately, the finder being in doubt as to its identity, removed it bodily, and although every effort was made to preserve the vitality of the root, it was without avail. The plant is still in the possession of the finder as a dried specimen. On making enquiries it was ascertained that the late Mr. George Oxenden, of Broome Park, an enthusiastic botanist, brought a number of plants of this variety from abroad, and planted them about the neighbourhood with a view to their being naturalized. Doubtless this was one of the few, or perhaps the only surviving specimen. The last in this neighbourhood previous to the one in question was found upon St. Alban's Downs, about twenty years ago.

It is a remarkable coincidence that a singular variety of *Orchis purpurea* was found almost on the exact spot as the O. hircina. This plant passed into the hands of Sir Joseph Hooker, who stated that it was quite different from anything he had seen before. Belonging to another family, the Primulaceæ, a pure white primrose has been found in the midst of a large wood. The plant was removed to a garden where it is still growing, but it is much more difficult to propagate than the ordinary primrose, evidently possessing a very delicate constitution.

Mr. William Jacob has in his garden an exceedingly pretty variety

of *Anagallis arvensis*, of a pale pink color, which comes perfectly true from seed. The original plant was found wild in a field about three years ago. In the same garden is growing a clump of the blue variety, *Anagallis cærulea*, also taken from a neighbouiing field, but although these have spread to a bed upwards of a yard square and touch one another, not a single cross between them, or any case of reversion to the type has been noticed. In the shrubbery of a neighbouring farm, *Geranium striatum* flourishes, and on the railway bank *Hieracium aurantiacum* is growing; this probably is an introduction, as the bank adjoins a siding where the continental goods' train is frequently shunted. *Serratula tinctoria* and *Gnaphalium sylvaticum*, are also reported from the same district. Amongst the grasses, *Briza minor* and *Bromus arvensis* have been found.—J. J.

Commensalism between Rooks and Jackdaws.—That the fraternity between these birds is not limited only to a similarity of habits, and fellow intercourse, the following will show—

"Whilst walking in the neighbourhood of Shakespeare's Cliff, Dover, my attention was directed to a great noise made by a parcel of rooks, which, with accompanying jackdaws, rose from a field where they had been feeding, and flew, lustily screaming, above and around me in the air; at first I took no heed, but as the jackdaws retired further from the scene, I noticed the rooks to become still more demonstrative, circling round, then settling for a moment upon the telegraph wires, or almost beating the ground with their wings as they flew near. Their cries increased, and were evidently notes of alarm; soon I came upon the cause, for I espied a young jackdaw capable only of a sustained flight of about a dozen yards, which had probably for the first time that morning accompanied the party. I was able to examine it and satisfy myself that it was not a rooklet, and then, having placed myself on some rising ground, I noted with pleasure the dénouement. Pleased with themselves for having driven the obtruder away, the rooks quieted down, but not so the jackdaws; *they* were not contented until assured the fledgeling was unhurt, and several couples approached seemingly for that object only. This I take to be a good instance of commensalism, the stronger bird taking upon itself the duty of custodian for the time being."—S. W.

A Lost Plant.—Salvia pratense, one of our wild blue flowers, and a local species, has not been noticed for the last two years in its Dover locality. It is feared that a farm thistle spudder has rooted it out as a weed, and unless some small outlying specimen has escaped his and our eye, we must, I fear, regard it as a lost plant to the neighbourhood.—S. W.

Ants and Aphides.—A great deal of nonsense has been written by several authors about the various domestic animals which ants keep.... The Aphides which are often found in ants' nests are not brought from various plants where the ants find them in their foraging expeditions, as is often supposed, but are kinds (and there are several) which live on the

roots of plants; and when, as is often the case, the ants make their nests near plants whose roots are infested with these Aphides they no doubt take the greatest care of them and utilize the sweet fluid which they secrete, but it would be useless to try to keep Aphides which live on the leaves of plants in an ants' nest, as they would be unable to obtain any nourishment, and the ants certainly could not feed them.—G. Saunders.

Perennial Wasps' Nest.—Hornets are well known to occupy the same nest if undisturbed for a succession of years, but this is not supposed to be the case with wasps. From a bank near Sandwich however, where there was a pretty strong nest of wasps in the year 1888, numerous females were seen to issue the following spring (showing that they hibernated in company), and the same nest having been left undestroyed proved a strong colony both in 1889 and 1890. It will be interesting to note if this year it be again made use of.—S. W.

Suspended Bird.—Occasionally, when winter has denuded trees of their foliage, the body of a bird may be noticed suspended in the fork of a branch, and this, as a rule, is attributed to its having been shot in such a situation, or upon being wounded, and escaping for a time, having lodged there after death, and not fallen to the ground, but it is probable that accident has often been the cause, although it is seldom one has the opportunity of witnessing the catastrophe.

Last winter a sudden scare caused a number of sparrows from a neighboring garden to seek temporary resting places in some trees opposite my windows; I was looking out at the time and perceived that one had upon alighting missed its foothold, and turning over it was hanging head downwards from its intended perch; it made strenuous efforts, but in vain, to release itself, its companions looking on with interest, but neither attempting any succour, nor emitting any cries. Flutter after flutter, some individually distinct, but in rapid succession, others sustained for some little time with pauses for rest between, were without avail, and exhaustion seemed soon to set in. Then the other birds left, curiosity on the part of some having been the only expression of the emotions shown by them. The struggles of the victim became fainter by degrees, and the quiet periods longer, until twelve minutes had elapsed, when a relaxation of the foot muscles allowed the claws to close, then the weight of the body naturally drew the foot through the fork of the bough, and after falling only a couple of feet, the sparrow regained its equilibrium and flew away, apparently none the worse for being so near death.

Curiously enough the tree was a horse-chesnut, not one we should think in which such an accident was likely to take place.—S. W.

Rare Birds in Kent.—Several specimens of the Black Tern (*Sterna nigra*) have been killed near Lydd, where a few are annually met with; a Spoonbill (*Platalea leucorodia*) was also noticed, but this was not

secured; early in June a Honey Buzzard (*Pernis apivorus*) in excellent condition was shot at Sandgate; and a remarkably fine example of that great rarity the Alpine Swift (*Cypselus melba*) was picked up on the 6th July in an exhausted state, consequent no doubt upon its long journey from the Continent.—G. G.

A Family of Porpoises.—During the summer of 1886 a porpoise was seen very near the head of the Admiralty Pier at Dover. Its visits continued sufficiently long for it to become somewhat tame, but upon the approach of winter it disappeared. As spring was merging into summer the following year, a specimen, supposed to be the same, was noticed to frequent the spot, accompanied by a younger companion; but assurance became doubly sure when in 1888, the porpoise appeared about the same date as before, with two extra in number this time, whilst two more were added to the family party in 1889. Throughout the spring and summer of this year the six showed themselves daily when the weather was favorable. The spot chosen for their gambols was just within the angle formed by the fort at the end of the pier, out of the action of the tideway, but not in slack water, and they probably through their confidence or fearless conduct, must have been observed by thousands of spectators during the season. It was noticed that the mother and one of the cubs were of a much lighter hue than the others, which were easily identified one from the other. None were seen last year; probably they were deterred, if not frightened away, by the engineering works now in progress at the pier-head. A shoal was once or twice reported off Shakespeare's Cliff, but no evidence was to be obtained that it was the same family.

It has been more than once surmised that shoals of porpoises consisted of family groups; but so far as we know this has been assumed upon no other foundation of fact than that they are generally seen in small parties. This appearance at Dover seems to partly corroborate such a state of things, but if so, the mother must be the head of the shoal; at all events until puberty of the individual members, who may then perhaps forsake her leadership. But what about the adult males? are they solitary in their habits, or do they, like some of the pachyderms, associate together in droves by themselves?

Herring Gull.—After Mr. Gray's paper a note was read from Mr. G. Dowker, describing a tame male gull which he had had about two years, and which had been kept in confinement some years before it was given to him. He makes no attempt to go away, and he can stand up bravely for himself against either cats or dogs. He makes no great effort to obtain food for himself but expects to be fed. He is fond of meat and especially of fish, though he is omnivorous; if his food is 'high' he seems to like it all the better. Cold or exposure seems to have no effect upon him, and he generally rests at night in the most exposed place he can find. He is at times very pugnacious, and has been rash enough to attack both a gander and a cow, from both of which he was

happily separated in time to safe his life. He often quarrels with a small terrier and is always the victor. His hearing is acute, and he is as good as a watch dog, for he knows the usual frequenters of the house, but when strangers come he sets up a discordant noise.

Loss of a nesting place for Guillemots.—The high cliffs near S. Margaret's have been since the memory of man, a favorite breeding place for the Guillemots. Their chief place of resort was a large shelf overhung by a very formidable looking projection of the cliff, familiarly known in the neighbourhood as the Guillemots' House. This, in 1890, gave way and carried the shelf with it, thus depriving the birds of a home. Early in July I was walking along the cliffs at the top, when my attention was attracted to the sea by the unusual clamour of the guillemots, and on looking over I saw two immense flocks of these birds, numbering I daresay nearly a thousand in all. This unexpected sight, I found upon enquiries, had been perceivable for some time, owing to the loss of their usual breeding ground, as great numbers had come to the locality, but owing to the cause above named could not find footing upon the cliff, where scarcely a shelf of any size remained.—G. G.

TERMS OF UNION UPON AFFILIATION WITH THE EAST KENT NATURAL HISTORY SOCIETY.

In order to promote the combination and co-operation of other Societies or divisions of them, in the County of Kent, that are organised for the purpose of carrying out the same objects as the East Kent Natural History Society, namely, *the collection and diffusion of practical and theoretical knowledge respecting Natural History in all its Branches,* such Societies or divisions of them may be affiliated, provided the following Terms are agreed to beforehand by the Societies or divisions of them desiring to be affiliated.

TERMS.

(*a.*) That the combining Society will undertake local scientific investigations, and communicate the same for the purpose of Publication in the adopted medium agreed upon by the joint Societies.

(*b.*) That a consultative and publishing council shall be appointed, consisting of a proximate number of Delegates from the combining Societies. It shall be the purpose of the Council to consider and determine the particular investigations to be made by the Societies with a view to united reports thereon, to select and decide on the Reports and Papers contributed by the Members of the Societies that shall be printed, and to make arrangements for and supervise the Publication of the combined Societies.

(*c.*) The number of delegates from each Society shall be one for every 20 of its Members, provided the number of delegates shall not exceed three from any Society.

(*d.*) The Council shall make an Annual report of its Proceedings to a Meeting of the combined Societies, which shall take place at some Town in the District of the Societies previously agreed upon, some time in the Spring or early Summer, when a conjoint excursion shall form part of the proceedings.

(*e.*) A capitation fee of one shilling per member shall be contributed by each of the combined Societies, provided the sum from each Society be not less than £1. These fees shall be for the expenses of the Council and for publishing the Transactions, the balance available for publishing to be added to any sum which the Societies may otherwise contribute for that purpose.

(*f.*) Each Society shall manage its own affairs and publish its own Report on business and finances, but its members shall be considered honorary members of the other combining Societies, and have the privilege of attending the scientific meetings and joining the excursions, on giving proof of their membership. Each member of the affiliated Societies shall be entitled to a copy of the publication issued by the Council.

VOL. I. PART III.

THE

The South Eastern Naturalist.

THE TRANSACTIONS

OF THE

Associated Natural History Societies

OF THE

SOUTH EAST OF ENGLAND.

PAPERS AND NOTES

BY THE MEMBERS OF THE

East Kent Natural History Society, and of the Dover Natural History and Antiquarian Society.

Canterbury:

GIBBS AND SONS, PRINTERS, 43, PALACE STREET.

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TRANSACTIONS.

XVII.

REPORT ON TEMPERATURE OF AIR AND WATER AS TAKEN AT THE RIVER STOUR, CANTERBURY, DURING THE YEAR 1890.

BY THE LATE

COL. W. H. HORSLEY, R.E.

The following remarks on the above-mentioned subject are in continuation of those given in the report for the year 1889, and furnished to the Committee of the British Association appointed to arrange an investigation of the several variations of temperature in lakes, rivers, &c., in various parts of the United Kingdom. The paper was also published in Part I. of the South Eastern Naturalist.

In the report for 1889, it was stated that in the months of November and December the fluctuations of the relative temperatures of air and water were frequent, but speaking generally, the water temperature was higher than that of the air. The same remark applies to the observations taken in January, 1890, though there are some remarkable exceptions, showing that the temperature of water is not influenced so quickly as that of air.

For instance, the temperature of the air, which had averaged 39° in the first five days of January, suddenly rose on the 6th to 51°.3; while that of the water, which had been 44° on the 5th, only rose 1°.6 on the 6th of the same month. The same was the case on the 12th of January, viz.: air, 51°, water, 48°, with the wind S.W. & W., and again on the 16th and 19th, air, 50°.3, water, 47°.5, on the last mentioned date. Another remarkable instance is reported on the 25th January, air temperature, 54°, that of water, 44°.5, difference, 9°.5, that of air having risen suddenly from 37° on the 24th, to 54° on the 25th, while that of water had only risen 2°.5 in the same interval. The weather throughout January was unusually mild, the wind for the most part S.W. with occasional rain.

In February, the temperature of the water was, with one single exception, higher than that of the air; that exception proving the rule mentioned above. The exception occurred on the 13th, the temperature of the air suddenly rising from 31° to 45°, while that of the water rose only 1°, viz.: from 39° to 40°.

In March, there was a remarkably sudden fall in the temperature of the air, viz.: from 29° on the 3rd to 14° on the 4th. The frost on that day was the severest that had been experienced in the memory of "the oldest inhabitant," and told hard on water pipes and shrubs. On the same dates, the temperature of the river Stour was 37° and 36°, a difference of 1° only, while that of the air was 15°.

The severe frost did not last long, for, on the following morning, viz.: the 5th, the temperature of the air rose to 38°.3, and that of the water was 38°, or only 2° higher than it was on the 4th. Further instances of the rapid rise in the air temperature as compared with that of the water are observable in the observations taken on the 6th, 7th and 8th of March. And again on the 9th, a rapid fall of the air occurred, and little or none in the water temperature, wind N.W. and weather fine.

Observations were omitted in April, May and June, as the observer was not furnished with a book to enter them in. In the month of July, the temperature of the air usually exceeded that of the water, as it might be expected it would. The highest air temperature was 71° on the 17th, and that of the water, 62°, difference, 9°. The lowest air temperature, 55°, and that of water on the same date, viz.: 11th, 57°, difference, 2°. Wind generally westwardly, veering to N.W. and S.W, with occasional showers, but generally fine.

The same rule, as regards the relative temperatures of air and water, applies to the observations taken in August and September, the water being invariably the colder, though not more than 6° or 7° difference, and often less, especially towards the end of each month.

In October, a change is observable, the water being frequently the warmer of the two, notably on the 22nd and 28th, when the difference was 9° and 10° in favour of the water, with a cold easterly wind on the former date, and N.W. on the latter. A further instance of the sudden rise in the air temperature, as compared with that of the water, is seen by comparing the observations taken on the 28th and 29th of this same month. A warm S.W. wind caused the air temperature to rise 10°, while that of the water remained the same on both days.

The same remarks are applicable to the month of November, the water temperature being usually the higher of the two. The exceptions will be seen in the observations of the 13th, 15th and 23rd. On each of these dates there was a sudden rise of air temperature, and no corresponding rise in that of water. The wind S.W., and the weather dull and wet. The lowest air temperature in this month was on the 30th, viz.: 22°.5, water being at the time, 38°, differerence, 15°.5.

December, 1890, was an unusually cold month, the thermometer standing at or below freezing point for 20 out of 31 days. It opened with 14°.5 of frost on the 1st, on which date the water was 37°, or 19°.5 warmer than the air. This state of things, however, did not last long, for on the 4th, the temperature of the air was 4°.5 higher than that of the water. As a rule, however, the water temperature was

higher than that of the air throughout the month. The Stour being a running stream, the surface was not frozen, even with the air temperature at 18°; on the contrary, the water temperature on these days (13th and 14th) is recorded at 36° and 37°, that is 18° or 19° warmer than the air. The wind for the most part was from the cold quarter, viz.: E. and N.E. A fall of snow occurred on the 18th, with the wind at E.S.E.; and again on the 27th. The weather throughout the month was dull and cold.

It only remains to state that the observations referred to in this paper were taken at the same place and time, and by the same person, Mr. Henry Dean, as those previously recorded, the depth of water being about two feet in the ordinary state of the river, increasing to three feet or more when it is in flood. The direction of the stream is from S.W. to N.E. The banks are low, and shaded with trees.

XVIII.

REPORT OF E.K.N.H.S.' EXCURSION TO RECULVER,

On August 13th, 1891,

BY

MR. G. DOWKER, F.G.S.

The Excursion was a very successful one and was well attended, a contingent of Dover Members joining the waggonettes at Canterbury. The route to Reculver was taken by road from Canterbury, viâ Sturry, Bloomfield, Herne, and Beltinge, where the party alighted, and were conducted by Mr. Dowker to Old Haven Gap, Bishopstone.

Mr. Dowker gave a short account of the geological features exhibited in the cliff sections, pointing out the divisions between the London clay beds, the Old Haven and basement beds, the Woolwich beds, and the Thanet beds. The dip in the strata towards the N. West brings these beds to the surface in succession, and nearly the whole of the lower London tertiary beds were here exhibited, except the lowest of the Thanet, that rested on the chalk which had been denuded by the Wantsum estuary that separated Thanet from the mainland. This last of the Eocene series was here 80 to 90 feet thick as had been proved by a well sunk at Reculver, reaching to the chalk. Mr. Dowker referred to the great changes that had taken place along the shore by the advance of the shore line along the cliffs, and the constant change on the fore shore caused by the accumulation or removal of beach and land, so that on the many occasions during the last thirty years when he had visited this spot, it had never presented the same appearance twice in succession. This gap at one time yielded a rich harvest of fossil shells in the strata exposed at low water, which were now hidden beneath sand and beach. From this point the excursionists walked beneath the cliff to the Reculver Church; Mr. Dowker pointing out the fossiliferous beds in passing.

At Reculver, Mr. Dowker shortly reviewed the history of the place from Roman times, noting in particular that the church was situated near the centre of the ancient castrum Regulbium, the walls of which in part remain, although that on the north has been washed away. The Church, therefore, now occupies the place of the Roman Prætorium. It is found to be largely built of Roman tiles, and at the Eastern end there was an apsidal terminal wall; between this Chancel and the Nave were formerly two Roman pillars supporting brick arches of Roman tiles. The documentary evidence dates back to 660. So the Church may be claimed to be one of the earliest in England.

The twin towers of the church are very conspicuous, and are used as a sea mark by the Trinity Board. There is a legend that they were built by the Abbess of Davington, to mark the spot where her sister was wrecked at Reculver, and to serve as a guide to future mariners. After viewing the church, the excursionists walked round the eastern and southern walls of the castrum.

Botanical.—Plants noted in the cornfields.—Linaria spuria, Lepidium campestre, Cakile maritima, Alyssum maritimum (this plant, which is far from common, was gathered by Mr. Dowker from off the Roman wall of the Castrum). Along the sea shore.—Beta maritima, Atriplex littoralis, and laciniata, Polygonum persicaria, Plantago coronopus, Convolvulus arvensis, and Calystegia sepium, on the beach.

XIX.

THOUGHTS IN A GRAVEL PIT.

Abstract of a Popular Lecture,

GIVEN BY

MR. G. DOWKER, F.G.S.,

AT DOVER, 22ND FEBRUARY, 1891.

The Lecturer first pointed out that the "Gravel Pit" was a purely hypothetical one, but that it might be considered, (as regards East Kent) to be a typical one, similar to so many in various parts of the country. He continued—"The spirits we shall call up to answer the various questions that present themselves, will be the spirits of departed *man* that had witnessed the mammoth browsing in the forests of Kent, hunted the reindeer of the plains, or tracked the cave bear to its lair. But in addition to the evidence of this great progenitor of Adam, we shall call upon his latest descendant, the scientific man of the present century, for his assistance in elucidating the various problems that gravel beds present.

It may probably be imagined that the Geologist, who has read with such clearness the older rocks, tracing them in successive order, and unfolding their history by an examination of their organic contents, will have little difficulty in deciphering these newer beds. Such however is not the case, on the contrary, no more difficult questions have been propounded of him to explain the changes in the more recent history of our globe, than those connected with the post tertiary period, but there are certain broad and well ascertained facts that we may and must examine before we are capable of forming any sound conclusions on the whole matter, and I propose to set them before you this evening, avoiding as much as possible any dry details.

The questions we have first to answer, may be epitomised as follows:

1.—Of what materials is the Gravel composed?

2.—Whence were the materials derived?

3.—By what means have they been brought into their present position?

On the first point I would observe that all the gravels of Kent are composed of materials derived from the older beds in the neighbourhood.

The larger portion consists of flint stones.

The hills between Canterbury and Dover are capped with flint stones in clay, which Mr. Whitaker calls "*Clay with Flints*," and these flints have evidently been derived from the chalk, by the latter having been dissolved and carried away by rain water. The chalk, being soluble in rain water, owing to the carbonic acid contained in it, has disappeared, leaving the flints behind, together with the insoluble matter of the chalk, which is the red clay, in which these flints are imbedded. The chalk about Dover has also upon it the remains of some old Tertiary beds of red sand, which is largely impregnated with iron. This has given the clay an unusually red colour, consequently, the original white coating of the flints is stained correspondingly.

Clay with flints, is not found upon these hills only, it occurs all over the district, and has even been washed down into the valleys around to the level of the present rivers. In such low-lying situations, the floor of the valley is covered by the stones, washed and partly rounded by water action into subangular gravel; while higher up, often in terraces above the level of the present valleys, are patches of water-worn gravel, often containing small rounded pebbles of iron sandstone, and chert, from the Lower greensand. These constitute our river gravels or drift, and we shall find this river drift spread out in similar thick sheets or terraces corresponding with the direction of the rivers of the district, but at a very considerable elevation above their present level.

Now it is chiefly in this river drift that our Kentish gravel pits are quarried; and, moreover, it is amongst such gravel that we find the remains of the extinct mammoth, and, contemporaneously the evidences

of man. Hence my stand in a hypothetical gravel pit of this character, which we may suppose to be situated upon the north side of the Stour, near Canterbury.

The second question now presents itself—whence were these materials derived?

Clearly from the chalk, ab initio, but in our gravel pit not directly, for the former lies many feet below, and between the two intervene Eocene beds of sand and pebbles; the latter covered with London clay. The chalk flints composing our quarry, must then have been transported from some other part where chalk reaches the surface. The gravel contains too, some rounded black pebbles, small in size and slightly flattened in shape, very dissimilar to the large rounded boulders of different tints, shaped by the rolling action of the sea upon our present beach. Where did they come from? If we are acquainted with the Thanet, Woolwich, and Oldhaven series of the Tertiary beds resting upon the chalk, but beneath the London clay, we shall recognise these black pebbles as belonging to some one of them; but as we may likewise find in the gravel pieces of sandstone and ironstone identical with those in the tertiary beds, it makes the derivation of these materials doubly sure.

Thirdly:—How were these heterogeneous materials brought to their present position? We know that the sea is one agent that carries up material into beaches. But these beds are evidently very different from sea beaches, and there is no evidence of any modern sea having been near! Rivers we know also heap up the materials carried by their running waters, and if the flow be of sufficient depth and velocity, it will also remove and redeposit gravel. Rivers of a torrential character abrade the older beds over which the waters flow, to carry and mix up the materials so similarly to these that we may safely assume this to have been the mode of action.

But supposing these beds were thus formed, how could the present streams (at a far lower lever and with little velocity), have shaped these terraces? The answer suggested is that at some former period the rivers occupied a much higher position, and that in progress of time they have cut their beds down to the present level.

Our examination of the gravel pit has then led to several important questions, and the answers may appear conclusive, but they demand that a long period of time should have been occupied by these actions, and under several climatal conditions that no longer exist. For corroboration our typical pit may be compared with existing ones in similar terraces, along the high banks of the rivers Thames, Medway, and Stour, and their contiguous streams, which all present the same characters, and show no signs of unequal elevation or depression. We now invoke the spirits of the geologists to tell us something more.

First, an examination of the gravels themselves, or the brick earths with which they are associated, (or which often replace them in position) has yielded to the attentive examiner a number of fossils; amongst these

rather abundantly bones of the mammoth and other animals, associated with extinct and recent freshwater shells. The latter, found in the sands and clay, show no signs of having been violently washed up to their present positions, or they would have been broken, if not entirely destroyed. This proves that when the waters prevailed in the valleys they must have been at times comparatively tranquil, and certainly long enough for the lives of several generations of the species. The remains of the mammals belong chiefly to the families Ruminantia and Carnivora, the former abundantly, the latter rather more sparingly distributed. The bones are not much rolled or broken, are generally well preserved and often perfect, but seldom indicative of a perfect skeleton having been entombed upon the spot. At Ilford, in Essex, in 1868, in a pit of brick earth, the following interesting assemblage of bones was found :—To the right a huge tusk of *mammoth*, 8-ft. long, across which lay a fine antler of *red deer*. at a little distance the frontal portion of the skull of *urus*, with bones of various animals scattered around—*horse*, *rhinoceros*, *bear*, and *wolf*. The place was evidently the bed of an ancient river, as shown by the sand upon which they rested being covered with shells of *corbicula fluminalis*. A similar assemblage of bones is related by Camden to have been discovered at Chartham, at a depth of 17-ft. below the surface.

Only two species of elephants are now known to exist, (both inhabitants of tropical climates), and from the habits of these animals it was originally inferred that their former presence in England demanded similar conditions, but the remains of the mammoth have not been found so near the equator, whereas from the 40th to the 60th degrees of latitude they are abundant; ranging throughout England, France, and Germany, as far south as Rome, and to the eastward through Russia and Siberia.

In 1803 the famous Adams' mammoth was discovered at the mouth of the Lena, with its flesh so well preserved by the ice in which it was imbedded, that it was eaten by bears, wolves, and dogs. Mr. Adams was able to obtain the whole of the skeleton, which is now in the museum of St. Petersburgh. Another was found between the Obi and Yenesei near the arctic circle. These animals differ from our present elephant in their peculiarly shaped head, strongly curved tusks, and their covering of long black hair with an undercoat of reddish wool, as though to fit it for the rigour of an arctic climate. A rhinoceros was supposed also to inhabit only warm countries, but the tooth of one found in Siberia showed in its interstices fragments of pine leaves and coniferous wood which had been chewed by the animal and still remained; and pine trees are indicative of subarctic circles, so that these creatures evidently lived in the regions where their remains are now found. These two animals were of vast size compared with those of the present day as were also the extinct bear and hyæna; the former equal in bulk to a large horse, and the latter much greater than any of the hyænas of the present day. With these are associated the remains of animals of an opposite

character, such as the aurochs (or ancient bison) the reindeer and musk ox. The reindeer now flourishes in the Arctic regions, its home is amongst the snowfields of the northern hemispheres, whence it migrates in winter to more southerly climes, and we may reasonably infer that these ancient reindeer had the same habits. We may also suppose that if in ancient times they had to travel to the highlands of the continent of Europe for the summer, there must have been some connecting land or bridge of ice over which they could pass each season.

We have before seen that in all probability these old gravel beds were deposited at a time when the land stood at a much higher level than it does at present, and as we find there are no evidences of a *partial* elevation of the country, we must conclude that England was then part of the continent, and the North Sea, as such, had then no existence. We arrive at this conclusion from the fact that the bed of the North Sea is nowhere very deep, that trawlers are constantly dredging up elephant remains from the bottom, whilst all along our eastern coasts, and especially in the mouth of the Thames there are peat beds and submerged forests containing similar evidences.

The lecturer then proceeded to consider gravel pits outside the county, and explained the nature of the Glacial drift, Boulder clay, Cromer beds, and post-glacial gravels, his object being to show that the higher river gravels were later than the glacial drift, but perhaps coæval with the boulder clay in the North, and to explain the terms pre and post-glacial deposits so frequently made use of by authors treating of the "Antiquity of Man," whose remains as typified by his implements imbedded in the gravels he next referred to. He stated that in addition to the knowledge derived from the study of the gravel, brick earths, and similar deposits, the revelations of the contents of caves and caverns which man had occupied for refuge or habitation, had proved of great assistance in corroborating the opinion of the geologist formed from the former, and instanced that the remains of man preserved in such situations by the stalagmitic flooring showed that successive races had made use of the same cavern. Another set of observers had directed their attention to the lake dwellings and rubbish heaps with commensurate success, so that now a very correct idea of his life and habits could be formed.

In conclusion he urged that;—

1.—The gravels and brick earths of the valleys of the Thames and Stour, were deposited by an old river or rivers flowing in the same general direction as at present, and that these gravels may therefore be properly classed as river drift.

2.—The old river must have been larger and of a more torrential character than the present The size is shown by the wide tract within which it flowed. The swiftness by the coarser character of most of the deposits.

3.—This increase and power might be owing, in part, to the greater height of the land, causing greater condensation of atmospheric moisture, and heavier falls of rain or snow.

4.—That at this early period England was united to the continent; and the Thames and the Rhine flowed northwards through a low tract of land occupying the place of the North Sea, and further. that there were then some glacial conditions which affected the northern parts of Europe.

5.—That the terraces of river drift were formed in succession from the highest to the lowest, there having been alternate periods of erosion, and deposition.

6.—That the cutting out of the valleys to this extent is locally post-glacial.

7.—That the fact that man might have lived in the Thames valley, while the North of England was under glacial conditions and uninhabitable, is quite reasonable and very probable.

8.—That two sets of animals now extinct in this country existed, the remains of some of which are found associated with the works of man, in the gravels; viz., the reindeer, musk ox or sheep, rhinoceros, and the aurochs in the northern—the mammoth, hippopotamus, cave lion, and bear in the less northern region.

9.—With the exception of his works, no traces have so far revealed what sort of a man this was. The skulls and other bones that have been met with hitherto, have not been clearly identified as of this paleolithic age, for primitive man probably did not take the trouble to bury his dead. The bones of the mammoth and reindeer which have been found with his weapons, are for the most part in a decomposed state, only the ivory tusks, teeth or horns remaining. It may then be easy to account for the absence of man's bones under such circumstances.

10.—A second race of men succeeded, whose works survive them. From the caves (not the gravel) we get their history; they lived contemporaneously with most of the animals mentioned, and scratched their likenesses upon fragments of bone or ivory. Further they made needles and probably sewed together skins for attire. They appear to have been very like the Eskimos of the present time, and so far as we can judge, were the earliest civilized people on this part of the earth.

XX.

EAST KENT NATURAL HISTORY SOCIETY,

Abstract of

WORK OF SCIENTIFIC SUB-COMMITTEE.

Sea Temperatures.—Temperature of the Channel, at Dover, was carefully recorded up to end of August, 1891, in accordance with the suggestion of Special Committee of British Association.

Since that time the temperature has been taken at intervals. Up to 15th January, 1892, the temperature has not been lower than 42 F., although the air has been as low as 27 F., at nine o'clock, with snow.

Geological Photographs.—Geological photographs, taken at the request of the photographical section of the British Association, are forwarded with explanatory diagrams to that department, marked with their register numbers, and preserved in the album of that society. They are intended to show the profiles of cliffs, for the purpose of recognising and recording the amount of coast erosion. Those taken are No. 414.—Shakespeare Cliff; showing Belemnitella bed, dividing Lower and Middle Chalk.

No. 415.—East Cliff, Dover, showing Middle and Upper Chalk.

These photographs, 10-in. by 8-in. were by G. Amos, 12, Snargate Street, Dover.

Photographs of the cliffs at the Cornhill Station. Photographs of landslip above Folkestone, by which a house was swept away and three persons killed, 21st January, 1891. These 5-in. by 4-in. photographs were taken by Captain McDakin.

Coast Erosion.—Coast marks from Folkestone to St. Margaret's Bay, have been compared with the six inch ordnance map of 1876.

J. GORDON McDAKIN,

15, Esplanade,

DOVER.

XXI.

ANALOGIES OF SOCIOLOGY AND BIOLOGY.

Paper by the

REV. T. FIELD, M.A.,

Read at Canterbury, Feb. 8th, 1892.

The Lecturer said that his aim was to show, how in the ordinary course of our life, our business, our Government, even our schoolboys' games, a process is going on which is in its essence, the same as that on which the long and majestic course of creation has proceeded.

By the simple illustration of a large business as the growth and development from a small beginning, he illustrated the change from what is simple to what is complex, from what is uniform to what is different in its parts, from what is homogeneous, or alike in pattern throughout, to what is heterogeneous, it involves in fact, differentiation and specialization of function. These two phrases, differentiation and specialization of function, were to be the key to his subject.

He said, differentiation means the setting apart of different members for different work, and specialization of function means their gradual adaptation to their special work in such wise, that in physiology at least they become unfit for any other purpose. He proceeded :—" Now, with this idea in our minds, let us survey the world of life. Just as the world of commerce stretches from the lowly barrows of the costermongers to the towering palaces of the London merchants, and includes every intermediate grade, so in like manner the world of life stretches from the lowly yeast cell, or the zoophytes and protozoa, at one end, to man at the other. It is of course the received belief in the world of science, that in the world of life, through the course of countless ages, the higher species have been evolved or developed from the lower, that there is no breach of continuity any where, but that by gradual improvement this mighty progress has been brought about. Of this I propose to say nothing to-night, all I shall try to show is that the point wherein the higher species differ from the lower, is in differentiation and specialization of function. There is one further direction in which I shall trace this progress, and that is in the life history of the higher animals, from the embryo to the full formed organism. If, for example, we take the egg of a fowl and watch the different stages through which it passes during the time of incubation until the full formed chick bursts the shell, we shall see the same process going on. What a wondrous process it is, and yet it is one of differentiation and specialization of functions, the gradual formation of separate organs, each fitted for its own work and for no other. I will now illustrate this principle more in detail, first, by surveying the world of life generally, and passing from the lowest to the highest forms, to show how the highest differs from the lowest, precisely in this higher degree of differentiation, and secondly, by taking the life history of one single highly organized creature, and showing you the different stages.

It will be well to give a moment's thought to our own frame work; to realize more fully the specialization of function. There is one part of us, and only one part of us, which can do the work of digestion; it is no use to put food in our nose. The eye, and the eye alone can see, and it can do nothing else. The nerves, and the nerves alone can feel, when we have a toothache, the dentist kindly kills the nerve, and toothache in that tooth at least is impossible. The lungs give oxygen to the blood; they have no other purpose whatsoever. To some slight extent the blood receives some oxygen through the pores of the skin, but that is of little purpose if the lungs do not work. The veins carry blood, and do nothing whatever else, so that we have a series of organs highly specialized, limited each for its own peculiar purpose. Let us turn to the other end of the scale. The simplest form in which we find life is what we call a cell. This, if you will forgive me a simple illustration, is something like the capsules in which we now give cod liver oil to children; there is a sort of gelatinous bag, and an apparently homogeneous substance inside, of course microscropically small. The cell is in principle the same in low

forms of plant life like yeast, or animal life like protozoa. Let us take these rudimentary forms of life; to all appearance they are little pieces of jelly; microscopic investigation cannot discern any difference of tissues, or any special organs, all it can distinguish at the most is some arrangement of cells. What then distinguishes this as a being, as a living thing, and makes it different from mere jelly? It has sensation. Watch it when some small foreign body approaches it, it seems excited, when the body touches it, its jelly-like substance enfolds it, holds it fast; if the body is capable of yielding nutriment, it is held in its folds until it dissolves and becomes incorporate in its system; but, observe there are no special nerves to feel with, the whole substance is sensitive; there is no special digestive apparatus, it appears to absorb nutriment at every point of its surface; and similarly some of these beings appear sensitive to light, but there is no separate organism like an eye to receive impressions of light, the whole surface is sensitive. Nay, the amœba seems to have some sort of power of locomotion, as it can at pleasure extend part of its jelly-like substance (any part, it does not matter which), into a long process as if it were a leg, and so haul itself along.

It is impossible to trace in the chain of progress every link, but we will pass next to the cœlenterata of which the common sea anemone of our shores may serve as a specimen. Here we have a definite mouth and definite organs intended to bring nutriment to the creature. The echinus or sea egg takes us one stage further.

We now come to that group of creatures which Cuvier called articulata and modern zoologists annulosa. Here is a rough diagram of such creatures. In so wide a kingdom, including as it does insects, crustaceans, and worms, extending from a lobster to a butterfly, various degrees of complexity will be seen, and you observe definitely separated the three systems—blood, digestion, nerves—blood at the top; digestion in the middle; nerves at the bottom; and that is the arrangement throughout this kingdom, and gives it its unity. Here then we have a great step. In the protozoa feelings and digestion and nutrition are processes carried on by any or every part of the body indifferently. Now we have the great differentation—digestive system, blood system, nerve system, and we shall find that in this order they are developed. The first thing that lower animals develop, (and some higher animals most consider), is the stomach, the last thing that they develop is the brain. Now we will not pay much attention to our digestive apparatus, but—I make the remark rather at haphazard—it seems to me, some of the lower creatures have almost as elaborate and complex an apparatus as we have; but we will follow first of all the blood in its circulation, and see how organs are specialised for its work. First, there is a feeble fluid which courses slowly through what can hardly be called veins, the whole body does the pumping and the whole surface does the breathing. Having now traced this principle in Biology, let us return to those illustrations in daily life with which we began, and indeed there is no part of our complex social organization in

which this principle may not be studied. If we visit the Electrical Exhibition at the Crystal Palace, what a marvellous complexity do we find in the latest electrical machinery. There is the old signalling apparatus of 50 years ago—a man with a stick by day and a candle by night—surely simplicity can no further go. Then turn to the locking apparatus of the block system, and see the marvellous parts on the interaction of which the whole mechanism depends. But a more intelligible illustration is presented at our doors, in architecture. The earliest habitation of our race was probably a cave, next came some rude hovel hardly better, with one opening which served for door, window and chimney. Soon we get differentiation and specialization of functions; a hole is made in the wall to serve for light, and another for ingress and egress, the smoke however finds its way out of one of these, and has not its own proper orifice. Then we reach that development of civilization, an actual chimney. Next we need some separation between the room for daily occupations and the sleeping apartments; in oriental lands between the apartments of men and women; so we get the Homeric house, with store rooms, hall, sleeping rooms, and women's chambers; or a building is needed for the worship of the gods; let us trace its growth, simple at first, one square room, then for adornment we have the columns before it, then a division into outer and inner sanctuary, each member undergoes further sub-division, the columns must have base and capital, the front pediment architraves and triglyphs. In a temple like the Parthenon, the very names of the different parts form a very considerable vocabulary. Let us take our own Cathedral. In ground plan we have crypt, nave, choir transept, eastern and side chapels. The choir itself is sub-divided into choir proper, presbytery, and sanctuary, take each column, go down to the crypt, we find in early times one single shaft, yet it has its base and capital, we return to the choir, the shaft has other shafts grouped about it, in the nave we compare the elaborately fluted pillar with those simple cylinders of Anselm and his priors. Or shall we take a window in Norman times; we have a simple opening with semi-circular head, the Decorated Period associates this in varied groups, like the window in S. Anselm's Chapel, finally we have the fully developed product which can only be described accurately by a vocabulary of architectural terms. The passage from a Norman window to a Perpendicular like that at the west end of the Nave is a passage from the simple to the complex. But we have not done yet. Take any section of the choir, and look from floor to ceiling, we see three main divisions, the lower arcade, the triforium, the clerestory—there is indeed no part where we cannot see this principle of sub-division at work, heightening the interest and the beauty of the structure, and giving man bold scope for fresh triumphs of creative art as it is itself the product of imaginative genius.

Let us turn from Architecture to Politics. In early days and early states of society, those conditions of which we get so vivid a picture in the Bible, the king centres in himself all the various functions of

government. He often sacrifices for the people as priest, he leads them to war as commander-in-chief, he would lead the war galleys of his fleet as chief admiral, and lay down laws for his people's guidance, he sits in judgment at the gate, and before him people throng to have their disputes decided. But soon the business of government grows and becomes more complicated. The king must have his general to fight his wars, his chief justice to sit in judgment for the people. The key to the constitutional history of our country is this principle of sub-division. In the great council of our Norman kings, there are the germs of our present cabinet or executive government, our present Parliament or legislative body, our present Law Courts or judicial authority. The King's Great Council was all of these, but see how vastly complex each of these sub-divisions has grown. The Law Courts which are themselves only one off-shoot of the Great Council of the King, have Bankruptcy, Admiralty, Probate, Queen's Bench, and Chancery Divisions, Court of appeal and Committee of Privy Council; each has its own special business and confines itself thereto. Or, to take the executive; it may not usurp the functions of legislation, still less may it invade the privilege of the judicial bench. Yet, what a complex organization. Turn to the Summary in Whitaker's almanac and an examination of the *personnel* of the government offices will impress you with the magnitude of its operations far more than any words of mine. One small subdivision of this, viz.: the War Office has had its organization much discussed of late in the public press. And, why? Because it is not sufficiently sub-divided. As you are aware, the Navy is managed by a Board of Admiralty, and the office of Lord High Admiral has been put in commission. The Duke of Cambridge however still holds in his hands the multifarious functions pertaining to the office of Commander-in-Chief. This involves, it is said, considerable confusion.

It may be permitted to a schoolmaster to draw an illustration from the playing fields. In cricket, even in its earlier days, there must have been the rudimentary distinction between the batsman and the bowler, and the man fielding the ball. But each position in the field has now received scientific study, its possibilities have received scientific elaboration. A man gets his place in the University Eleven because he is an admirable wicket-keeper or cover-point: each man has his special capacities, and if stationed in any but his favourite place, finds himself at a serious disadvantage. In football the process of elaboration has proceeded within our own memory. When I was at school we played an unscientific game all in a lump. Now a man is a forward, or a back, or a half-back, or a three-quarter: and when he proceeds to the University from his school, he does not often change the place to which he is accustomed, and for which he has specialized, for any other for which he has not received the same training.

There is one point in connexion with education in which this specialization is as obvious, as it is, or may be, harmful. In old days everyone had the same training, everyone was forced through the same

intellectual mill. The same quotations from Virgil reappeared from time to time in Parliament, for they were part of the stock-in-trade of all educated persons. Contrast the actual condition of our public schools, contrast the condition towards which they appear to be tending with the happy monotony of thirty years ago. Now we have the boy who is specializing in history, or specializing in science, or specializing in mathematics. Three-fourths, sometimes more, of his time is spent on his one subject, in this he is prematurely forced, of all others he is practically ignorant. With much that has been gained in finding for boys a path along which they can go, instead of forcing them all alike along a road which is suited for only a proportion, there is in the over specialization and premature specialization of the present day, a risk of narrowing and impoverishing the mind. It is not sufficient to specialize in science, the field is far too wide, a branch must be chosen; let it be biology, this again is too vast, we must limit ourselves to a portion, let us say embryology. But there are many embryos, let us make a European reputation by the study of embryonic guinea pigs. In all seriousness specialization has changed and is changing the conditions of cultivated society as well as the methods of education. It is a loss that the common stock of ideas which all educated men are supposed to know becomes smaller, because in their own particular line the researches of specialists become more minute. When the chemist has to limit his special department to the paraffin compounds, or the student of insect forms to a branch of a subdivision of coleoptera, the mind seems to be imprisoned within the circle of a narrow round.

XXII.

SOME FORMS OF CHALK LIFE,

BY

CAPTAIN McDAKIN,

January 11th, 1892.

This lecture was not intended for publication, being a description of photographic lantern slides, exhibited by means of the oxycalcium light, without which illustrations it would lose much of its interest.

Captain McDakin referred to the great changes that took place in the vegetable kingdom at the close of the Jurassic period and commencement of the Cretaceous, and to those which took place in the animal kingdom at the close of the Cretaceous and commencement of the Tertiary. The curious approximation of the skeletons of ancient reptiles to those of birds was also described. Photographs of the typical forms of Foraminiferæ were shown, and reference was made to the eozoon and bathybius. The lecturer also exhibited some translucent chalk prepared by himself from cut sections by developing with dilute acids in a similar manner to that familiar to photographers. The mode of preparing these is given in detail at page 96.

XXIII.

OUR CLIMATE.

Abstract of a Popular Lecture

GIVEN BY

MR. G. DOWKER, F.G.S.,

AT DOVER, FEBRUARY 2ND, 1892.

In this Lecture Mr. Dowker drew attention to the fact, that the climate of the British Isles was governed by a great variety of physical and astronomical causes, and had accordingly altered from time to time. It was pointed out that to understand the problem, it was necessary to study all these factors.

The Lecturer briefly explained the astronomical aspect. The cause of the seasons, the position of the earth in perihelion and aphelion, the equinoxes, the direction of the earth's axis, and the changes that would be produced by any change in its direction; and it was noted that astronomers had calculated from the rate of precession of the equinoxes, and the nutations in the orbit of the earth's eccentricity, that a period of 21,000 years would be required for the seasons to make a complete revolution, and in half that time the earth's position at the summer and winter solstice would be exactly opposite to the present; so then the winter solstice would occur when we were furthest from the sun, and the summer solstice when we were nearest.

Physicologists were not agreed what the effect of these changes in the astronomical position of the earth in these opposite conditions would be; some, as Dr. W. W. Croll* and Sir Charles Lyell had endeavoured to minimise the effects, while lately, Sir R. Ball, in a treatise on "weather on glacial conditions," had arrived at an opposite conclusion.

Mr. Dowker then mentioned the disturbing causes that would influence the climate of any specified locality, summarising them as:—1st, Proximity of land to the sea; 2nd, Height of the land above the sea level; 3rd, Neighbourhood of high lands, or heated plains; 4th, Rainfall or clouds; 5th, Ocean currents; 6th, Prevailing winds.

With respect to the present nature of the climate (apart from astronomical causes), produced by physical or geological changes on the earth's surface, Mr. Dowker dwelt on the exceptionally equable character of that experienced in England. It was shown by the isothermals of mean temperature, that Great Britain is milder than any other country lying between the same parallels of latitude.

It was mentioned that formerly every writer had agreed that the present temperature of Great Britain compared with continental countries of the same latitude, was due to the gulf stream. The

* Croll on the Changes of Climate in Geological Periods *Phs. Mag.*, 1864.

Lecturer was prepared in a great measure to admit this, he also favoured the theory that this stream was produced on the principle of an exchange in specific gravities between the hot water of the tropics, and the cold water of the polar regions; but of late nearly all writers on the subject had followed Sir Wyville Thomson, in attributing it to the action of the trade winds. It was pointed out that any change in the ocean currents in past ages must have produced a corresponding change in the mean temperature of northern Europe. In a paper recently read before the Geological Society on the geology of Barbadoes, by Messrs. Jukes Brown and J. H. Harrison, these gentlemen had shown that the recent geological deposits of that island proved that they were almost identical in composition with the silicious and globigerinal ooze now found in the depths of the Atlantic, and the conclusion they arrived at was, that the whole of central America and the Carribbean region was deeply submerged during the pliocene period, leaving free communication by sea between the Atlantic and Pacific Oceans. This, the Lecturer explained, would greatly alter the climate of Great Britain by diverting the gulf stream, if not destroying it altogether. Adverting to the effect of prevailing winds, Mr. Dowker remarked that the relative heights of the land was shown by geologists to have undergone great fluctuations since the glacial epoch, and this again must have influenced the climate, irrespective of astronomical changes.

The Lecturer asked if it was not possible to trace some changes in the climate of Great Britain since the Roman period? The Romans seem to have introduced vines into Britain, and vineyards were once numerous, at present the climate does not seem to suit them. Our seasons, he observed, were greatly influenced by the prevailing winds, and were there not to be observed fluctuations in cycles of years in our climate? A change of wind occurring at the equinoxes was generally followed by a continuance of prevailing winds blowing from the same direction as when this took place; and the wind travelling round in an opposite direction to the sun was characterised by cold summers, and it was suggested that, inasmuch as the equinoxes influenced the wind in the case of the monsoons, so the latter might have its rotary direction altered at the same time, under certain astronomical conditions.

The Lecturer was not able to give detailed facts explanatory of the influences of the sun and moon on the wind currents; but inasmuch as their combined action influenced the water, he did not see why in the same way they might not influence the air.

It was briefly explained how the trade winds were affected by the rotation of the earth, and by the sun's heat raising the air in equatorial regions, and so causing an indraft of colder polar air towards the equator.

And the periodic winds, called monsoons, were cited as proving that when the sun crossed the line or equator, its influence was exerted on the wind, shifting its prevailing direction for a time either northwards or southwards; The ascent of the warm air over the heated plains of

Asia and Africa caused an indraft of the vapour laden winds of the South Pacific and Indian Oceans in the one case, and the dry air from the heated plains, in the other.

Although the effects of the sun and moon's attractive influences in causing tides in the atmosphere were insignificant by reason of the elasticity of the atmosphere, and its more readily yielding to the effect of heat; the Lecturer suggested that the combined effect of this power of gravity might be sufficient, under certain astronomical conditions of the sun and moon, to alter the circular direction of the atmosphere at the equinoxes and solstices so as to induce a prevailing northerly or southerly wind in our winter, and by that means cause a cyclic change of climate. This was thrown out merely as a suggestion. But it was evident we had cycles of favourable and unfavourable seasons in our European quarter of the globe.

XXIV.

THE CLIMATIC CHANGE NOW COMMENCED IN GREAT BRITAIN, AND ITS PROBABLE INFLUENCES ON OUR FUTURE FAUNA AND FLORA.

PAPER BY

MR. SYDNEY WEBB,

READ AT DOVER FIELD CLUB,

November, 1889.

Although the wise man declares that there is nothing new under the sun—and assuredly his proverbs and sayings are as applicable to our present every-day life and surroundings, as they were when uttered nearly three thousand years ago—yet there are constant changes, cycles if you please to call them by that name, that produce revolutions of life among the lower orders of the animal kingdom upsetting at least for a time the natural course of events, and tending towards those great changes in the life histories of the creatures or plants affected by them, that we are constantly reminded of when examining the geological sequences of the rock systems, whether expressed in a total change of climate or in a partial transformation of pre-existing circumstances.

For the purposes of this paper, I will ask you to cast your memories over the weather we have experienced during the last few years. In Dover we had a long and severe winter in 1886-87, and complaints of its great changes in temperature were not confined to the good people of Dover. In 1887-88 there was another winter of a duration almost unheard of for Great Britain; there were extreme variations of temperature, followed by an unparalleled summer; whilst in other parts of the

country, though there might not be similar weather, there were equally extraordinary changes. Last winter was of much the same character as that preceding it, and one description would almost do for the two, excepting that there was less snow and a less rainy latter end of winter and spring than usual. To what do these tend? What effects had they upon insect life last year and this? And what may we expect for the future?

In considering these questions we must first of all compare the winter of 1887-88 with other severe winters in the remote past as well as with more recent ones, first remarking that although approaching an Arctic winter in length, it was not a uniformly cold one; indeed it was trying chiefly from its rapid transitions and uncomfortable associations. A few days of frost alternating with days and nights of mild weather was the formula which occurred over and over again, with a fair average of storms, but not with so many consecutive days of rain as usual. The chief frost of the season followed and preceded by snow storms of varying intensity, a period we may call the true winter, did not begin until the end of January, but it continued until a few days before Easter. The only time we can compare it with is the early part of the year 1855, commonly known as the Crimean winter, when a late frost kept the ground frozen from January till the end of March, whilst snow in sheltered situations, black but not comely, lay under the hedges as late as Midsummer. Milder but still late winters have been so much the rule for some years, that they still live in our memories and need not be mentioned.

Severe winters of old, of which we have but scanty records, are those of 1092, 1281 and 1564; the latter was at its extreme intensity from New Year's Eve to the 3rd January. The first frost fair held on the river Thames was that of 1608, when it began to freeze violently on the 22nd December, and people crossed on foot between London and the bankside, *i.e.*, the river wall at Lambeth, from the 30th of that month until the 10th January, but the ice was not consolidated, only lying in huge blocks and at the mercy of the tide; afterwards, the cold increasing, the ice became firm, there were booths, &c. set up until the 2nd February, when a sudden thaw commenced, and the same afternoon the ice was quite dissolved and clean gone, spring quickly taking the place of winter. Then there was the famous winter mentioned in Evelyn's Diary, when the river was congealed from the beginning of December, 1683 to the 5th of the month of February following. Another frost lasted from the end of November, 1715, to the end of the following February. Others were from the 26th December to the 22nd January, 1740; from January 10th to January 15th, 1789, and from the 1st to the 5th February, 1814. Upon each of these occasions the Thames was frozen, and fairs or sports were held upon the ice, but the breaking up of the frost seems, with one exception, to have been the breaking up of the winter, and only those of the years 1740 and 1814 commenced after Christmas.

The fact of the Thames being frozen over must not be taken absolutely however as a proof that olden winters were so much more intense than those of the present day. The facilities for a stagnation of the surface water were then much greater, the obstruction caused by old London Bridge, and the frequency or infrequency of the use of the locks above bridge, were important factors in the case. I have, since the year 1860, seen persons cross the river by leaping from block to block of almost, but not quite, packed ice, and had there been the old stoppage of the water-way as in the last century, no doubt the entire surface would have been completely frozen over by the consolidation of the various floating masses brought down by the current, yet the thermometer at the time I speak of only registered 12° Fah., a minimum reached frequently in England, though perhaps for only a few hours.

If then the extreme cold has not exceeded that of old days, wherein do we differ? I think it is in the fact that the seasons are not so sharply defined as they used to be. The early frosts of Autumn are now succeeded by long continued open weather instead of by the heavy rains of thirty or forty years ago, or by the gradually intensifying cold of the prior series of years. The winter itself is modified and prolonged, instead of being sharp and short—and the cold nights, and winds of spring now run far very far into the summer quarter; in other words the true winter now begins later, and then continues longer. A singular corroboration of this may be seen in an extract from an entomological book, which recommends the collector soon after dark to visit open spots in woods, &c., when numbers of larvæ stretched out to enjoy the soft air on waking from their winter's sleep, may be found upon the herbage in February. This paragraph was written twenty years ago by Dr. Knaggs, but as he had already disposed of his collection of insects, it must be assumed to have been penned from knowledge gained some years previously; certainly such an expedition would have but poor results now, and probably several would have to be taken on very favorable nights before meeting with any success whatever. February too, was named Sprout Kale by our Anglo Saxon forefathers as significant of early growth, the two previous or true winter months being called "winter moneth" and "wolf moneth." I have not been able to trace to its origin the couplet "March winds and April showers, bring forth May flowers," but we all know how singularly inappropriate now the distich is, and how seldom our woods favour us with a floral selection for May-day, whilst hawthorn blossoms are quite as frequently as not seen in June as in the prior month. I have not mentioned that the dates I have given of the great Thames frosts are probably old style, which would place them 11 days later, and this would bring the breaking up of winter to about the middle of February, the time when Dr. Knaggs tells us we shall find genial days.

We are now able to answer one of our queries. To what do these changes tend? Firstly, the result has been an increase from 26 to 30 inches per annum in our rainfall for the South Eastern counties, or

400 tons additional water to the acre, an increase not to be regretted, owing to the far larger proportion of surface agricultural drainage than formerly:—it shows itself too in our later hay and corn harvests, the latter now being in a great measure dependent upon uncertain and very frequently wet times for sowing both in autumn and spring, with the consequent thin crops and weak straw.

So far we are assured of, but it is not the purpose of this paper to attempt to prognosticate what important fixed changes in the climate of our islands may result from a continuity of years of this character. Yet there are sufficient signs of the times to show us that we are actually living not in a recurring cycle, but in a transitional epoch, and although we do not ourselves succumb to the changes of atmosphere, as men are fitted by nature to endure extremes, both of heat and cold, yet other members of the animal kingdom are changing their habits, if not really dying out, preparing the way for a new flora and fauna, for the time when our present supersoil is converted into a rock system, should the earth so long continue.

There are many meteoric influences besides those I have mentioned, that I could quote were it desirable in support of my argument, but I pass to Natural History. Do we find in animals any evidences of this change?

In the higher orders the same counteracting influences exist as in ourselves, and we cannot expect to find more than the slightest traces corroborative of our subject until we reach the birds. The migratory examples of this order are marked with their own distinctive peculiarities, for with them (the swallow tribe perhaps excepted) it would seem to be a necessary adjunct to their well being, that there should be a certain difference of temperature between the station of departure and that of sojourn. This fact then unfortunately disposes of our hopes of learning anything from them, just when at first sight it appears most natural to expect something definite. Yet a very slight enquiry will show that many birds have changed their times and habits. Some that used to rear their young regularly in this country no longer do so, and the range of others, notably the nightingale, has become more restricted than formerly.

Amongst the reptilia our argument is assisted by the natter jack or striped toad, which need not now be considered a denizen of our northern counties only. It is well established in Northampton, Cambridge, and East Anglia, and has even put in an appearance occasionally in Hants, Surrey, and Sussex.

What is more astonishing still, is the fact that our fishes have been influenced in some way by the change. There were many that used to visit our shallow waters at stated and regular seasons for the purpose of spawning, which no longer come as they were wont. Even the appearance of the commoner sorts is uncertain, fitful, and irregular, so much so that our fishermen no longer know whether or when to expect shoals

of mackerel or herrings. Sardines have deserted the West coast of France, and the humble sprat disguised in various ways is placed upon the breakfast table instead of its more aristocratic relative. Per contra, the Sturgeon once a royal fish from its scarcity, and one accustomed to cool waters, is commonly seen on our fishmongers' slabs, and the Norwegian or small red lobster, is seeking a home on our shores. Could stronger proof be urged than this fact of changes of habit in these creatures? Well, if it be required, it is forthcoming by descending a little lower in the animal kingdom, amongst the examples we should imagine pre-disposed to resent any change of climate.

Every one knows a white butterfly by sight, even the London street arab has occasionally a chase after one, and the most casual observer will have noticed that after a time as spring turns to summer, these butterflies, which at first pleased our eyes by their brightness, become ragged and worn, until at last but few appear upon the wing; then their numbers increase again gradually as they are renewed by specimens from fresh stocks, and in August we see more than ever. This is owing to our warm months allowing the eggs deposited in May to develop once more to the perfect insect, and for the progeny of these again to pass through their minor metamorphoses before the end of the summer. Whenever this phenomenon occurs in nature we call the insects affected by it double brooded. That is, one whole round of the life history is accomplished the same year that the egg is laid, one complete cycle in fact and two-thirds of another, in other words two broods of insects and two sets of caterpillars, but only one of the chrysalis.

Many of our insects are thus two-brooded in the South of England, but as we proceed northwards we find such occurrences less common, or reduced to single summer appearances, although the same species in confinement, kept at an equable temperature, will produce three and sometimes more families in the year, thus clearly showing that the number is governed by favorable or non-favorable surroundings. Here, then, is a simple fact, well known to every entomologist. What shall we learn by looking a little closer into the working of it?

Of our annually captured 56 British butterflies, only 17 are claimed in our books as double-brooded, namely, four whites, three browns, two vanessas, five blues, one copper, and two skippers. In addition to these, we may add, if you please, three more, which are but casual visitors, by which we mean, that they cannot certainly be reckoned on to occur every year, although frequently taken in England. Of these three,* our specimens when captured are almost invariably of the second brood, the first being wanting, whereas fifty years ago, when equally scarce, it was possible to capture them at either or both times. One of these butterflies was certainly a constant double-brooded species one hundred years ago, and although exceedingly local, not rare where it occurred; in Haworth's

* Daplidice, lathonia, edusa, the Bath white, Queen of Spain, and Clouded yellow. Edusa is frequently seen in early summer, but as hybernated specimens.

time it was changing its character, appearing as he says, "in a very singular and unusual manner, a brood of it flies in May at Gamlingay (Cambridgeshire), but not near London, and another separate brood of it flies in September near London, but not near Gamlingay, and never contrary-wise." The spring brood is now lost altogether.

It is only fair to our subject to mention these three species, and we will altogether omit other British butterflies now admittedly lost to our lists, but reverting to those we still have amongst us we find the whites almost holding their ground, though I do not think apart from their bright appearance, many would object were the converse the case. But twice in the last ten years has the comparative paucity of the large white been noted in our journals. The wood white (Leucophasia sinapis) has been lost from not only many of our southern woods, but almost from counties, and is rapidly becoming single-brooded; which it is even already in some parts of the country. Of the browns, one, a most abundant garden species of my boyhood (Lasiommata megæra, the common wall) has already excited surprise by its lessening numbers, and enquiries are yearly made how long it will continue with us; whilst egeria, another of the same family has in places changed to a single-brooded insect, intermediate in its appearance between the dates when it formerly occurred, and the two broods of the last of the three (pamphilus) have become merged into a continual flight, but less in numbers; the first step towards a curtailment of the ends, and consequent loss of one of the broods. One of the Vanessas, urticœ, the common tortoiseshell, holds it ground, but the other one C. album is vicarious, sometimes being in excess in the spring, at others in the autumn, but seldom in both. The small copper even is becoming less in numbers and erratic in appearance, although its food-plants, dock and sorrel everywhere abound, yet the insect holds its own sufficiently to attract attention annually. The two skippers, tages and alveolus, feebly do the same, the summer brood of each appears dying away whilst the spring one is in abundant. But few collectors remember either of our small wood fritillaries euphrosyne or selene upon the wing in the Autumn as well as May, now they show themselves in June, and are universally single-brooded. Argiolus is occasionally abundant in the south of England, either in May, (formerly it used to be early in April,) or August, but not in both months, unless sparingly, and in many places it is intermediate and of one brood, and the other blues are also showing decadence.

This is indeed a black list, a change of 70 per cent upon our total number, yet it would be worse if I included the five butterflies formerly inhabiting these islands, but now lost to us, or almost so.

To go through our list of moths would be tedious, and we should come out of the enquiry equally badly, whilst a friend who has busied himself among the beetles for nearly fifty years, assures me that in that group too his experiences are the same. May we not assume the same influences to have affected the two-winged flies, *diptera*, and the

hymenoptera, that great order which includes our wasps, bees, ants chneumons, &c., especially when we remember that twice in fifteen years, has an uncongenial winter almost annihilated the humble bees, invaluable agents of providence, constituting as they do, the only certain insect fertilizers of the red clover.

I have often contended that a severe winter is not in itself inimical to insect life but rather the reverse, but with one or two brilliant exceptions we have had admittedly bad collecting seasons since 1860, and things are still going from bad to worse. I will shortly review the last from the points of my own observation.

In 1888 we noticed two of the spring butterflies in great abundance, the *holly blue* left the ruined walls of St. Radigund's and coursed merrily along our streets, whilst the pretty *orange-tip* was conspicuous everywhere in the country, but the caterpillars of these had of course fed up and undergone their usual preliminary metamorphoses in the autumn of 1887. The sweeping net at night showed that this plethora was not confined to these alone, larvæ of *galathea* the marbled white; *corydon* the chalk hill blue, and the moths *bipunctaria* and *gilvaria* were the commonest; these might have been obtained by thousands, whilst next to them in numbers, *sylvanus*, the large skipper, and the meadow brown butterflies were in great quantities; but a change came quickly o'er the scene and the heavy rains washed away and killed the larvæ which would have supplied our summer months with insects. May passed and we began to remark the absence of many of our usual species, indeed it was not until June was half through that common blue butterflies put in an appearance, followed by the Bedford or little blue, *alsus*, and the brown argus, *medon*. The brilliant-hued *adonis* also occurred in limited numbers, but this was not surprising as for some years it has been fitful in the early brood. The time when these insects appeared on the wing was at least a month late, but what then, they were there, and with bright sunshine; even a late season soon recovers itself in insect life; but sunshine in 1888 was only represented by the mystical x of Algebra, and two-brooded insects were unable to fight against circumstances. Week after week of cloud or rain, with a temperature far below the average, prevented any improvement, and when the time came that the second broods should have been on the wing, of course, they could not be met with. Many of our naturalists expressed opinions in the magazines that these broods were absent altogether, but I do not think this was the case. They were looked for in the autumn at their usual time for appearing, but of course were absent then, though certainly present later, although I saw neither *agestis* nor *phleas*, and but very few *adonis*. As regards the later insect, a second brood could scarcely have been expected, for instead of a rush coming out at the end of May, there were but few examples in June, and stragglers continued throughout the following months, indeed worn specimens at the end of August; a state of things that would not give an opportunity for many larvæ to feed up. The question with regard to them was, will the larvæ be able to hybernate and come out in the spring? will they stand over

until a corresponding time of the next year? or will the species like some of those I have mentioned, decay into a single-brooded insect? The present collecting season (one not unlike last year, in bad qualities) has answered the first two questions in the negative. The first brood of *adonis* has been conspicuous by its absence, being noticed indeed at only one sheltered spot near Dover, and the autumnal flight is very limited in point of numbers. Time must show whether we shall lose the species altogether, but I believe the future of this beautiful member of the family has been foreshadowed for some years, and the downward path has been entered upon. There will be an occasional reaction, but the end is sure; it might be represented by a zigzag or spiral line from the ceiling to the floor sometimes going a little upwards, but gradually tending downwards.

Now blue butterflies rank next to bees as fertilisers of the orchids, and pollen masses may as frequently be seen attached to them, though I doubt if they are so often got rid of legitimately. With the removal of fertilization one of the sources of perpetuation is destroyed, and with their loss we shall lose much, for who can tell how many ardent botanists have been led into their favorite pursuit by admiration for these curious and beautiful flowers. With the loss of small flies and hymenoptera we shall lose more; and should single broods of insects become the universal rule, although such change be only a gradual one at first, a very rapid decrease will be observed in the flora of the country. Botanical specimens common now must become rare or even extinct, and in spite of self fertilizing flowers a climacteric will be reached which will need, figuratively, but the slightest touch rather than a disruptive convulsion to overturn the present state of things altogether. Some will no doubt survive, like the giant sponges of the Norfolk chalk sea, or the modern representatives of the lily encrites—but unless special adaptation to circumstances should affect the masses of created life, in a comparatively short geological space of time, even by natural means, there will be, at least from a naturalist's point of view, a new earth; without cataclysmatic or volcanic agency being necessary to effect such an end.

XXV.

HIBERNATION AND HIBERNATING CREATURES.

Extracts of Paper

BY

MR. SYDNEY WEBB,

Read at Dover, March, 1890.

Having referred to the various hypotheses of the last century, as to what became of swallows and other birds during winter, and explained the phenomena which so completely puzzled good old Gilbert White, author of the *Natural History of Selborne*, he divided hibernating animals into three groups:—those that spend the winter in a completely torpid or somnolent condition; those that awaken from time to time, to doze off again; and those that accumulate a store of provisions for winter or spring use.

The British hibernators among the higher orders of animals are but few in number. They are the badger, squirrel, field-mouse, dormouse, vole or water-rat, and with one exception the bats; some are inclined to think the hedgehog also, but the author excluded this animal, saying he had frequently seen it in pastures searching for food when the snow was lying deep upon the ground.

It is a vexed question whether the stock of provisions, with which the partial hibernators provide themselves, is really intended for consumption during the winter, or for a vernal banquet upon finally awakening from their long sleep, at which time it might be an act of difficulty to provide at first a sufficiency of food. He referred to this strange habit of storage at some length, and having considered the various quantities, and keeping qualities of the stores, laid up by different creatures; he said the preponderance of evidence was in favor of the hoards being formed for temporary purposes only; and that in a majority of instances they were, even before the winter set in, requisitioned for food by their owners. The accumulations made by bees and ants were noticed, as well as the habits of those hibernating insects which made no store, but which pass the winter in immediate proximity to their food, the opportunity for nibbling at pleasure being thus afforded.

The hibernation of snakes in companies, massed together for the purpose of increasing their natural caloric heat, was considered as a fortunate habit for us, as when a winter assemblage is discovered nearly all fall victims. Winter too, frequently closes the passage by which entry was made to the cavity occupied; and thus the means of exit from the place of concealment is cut off. To the numerous slips of the land in the Folkestone Warren of late years, the author attributed the greatly decreased numbers of vipers in the last decade; and not to any precarious slaying of individual specimens.

Other reptiles, fishes, including eels which latter mass together as do the serpents, were then treated of, as well as the crustaceans and centipedes. He spoke also of insects of various orders, including the butterflies, eight of which often greet us with the March or April sunshine, though they have frequently to retire to rest again, after astonishing some few persons who do not know that this is not a sign of spring, but only a temporary relaxation of the hibernating law: and he showed that caterpillars hibernate at different ages, some even hatching into life but declining to leave the eggshell for a season.

In all these creatures it was explained that the *internal* animal-heat could not be reduced much below the freezing point without death speedily ensuing; but that with a natural warmth of two degrees above it for the higher orders, or five below for eels, many degrees of frost could be resisted, so long as the internal fat which all hibernators possess is not exhausted; but when from whatever cause this supply ceases, and a minimum of cold immediately succeeds the animal will succumb, whether beast, bird, fish, or insect. Finally, the chemical changes fitting

this supply for heart action during the time breathing in winter has been suspended, and consequently when no oxygen is taken in by the lungs of the animal, were fully explained; and the various interesting phenomena which combine towards this end, fitly closed a short but exhaustive paper.

[Note.—The title of this paper was suggested by reading a short article in the *Selborne Journal.*]

NOTES.

Bucolic Entomology.—Date, about 20th May, 1892.—Butterflies Sir, Noa! 'taint much of a season for them. It's too cold. There are a few little brown uns about, but they've no color yet. Yer see sur, they wants sun, then they'll turn blue and get lively; next they gets into the orchards and then they grow, they eats cherries and plums and that gives 'em scarlet streaks acrost the wings. You'll find plenty then, but not yet awhile.

Edusa in 1892.—This will long be known amongst entomologists as the great Colias edusa year, second only in importance to the celebrated season of 1877, when this golden colored butterfly occurred in profusion from one end of the British Isles to the other, even gladdening the dullness of our streets and the slopes of our northern mountains.

Although it has been everywhere recorded as common, in Kent at least, it has not with regard to numbers, nearly equalled the former date, yet in certain localities (of generally limited area) it has literally been seen in thousands. This better enables us to understand the nature of these visitations, and helps to disperse the clouds of mystery and surmise that have for so many years hung over our brilliant little friends. No longer is it possible to doubt that from time to time an incursion takes place from abroad, and when this happens in the spring, eggs are laid and a brood hatched out and brought to maturity the same season. From the same cause the numbers in which they appear can be accounted for, as we cannot expect our country to produce the parasites which are doubtless peculiar to them in their own, and therefore the caterpillars escape molestation; but Great Britain is too damp for the next brood to survive the winter, and it is not until another migration takes place, that we can expect to see them in any numbers. This is the solution of a problem which much exercised the minds of our older entomologists, but they attempted to explain it by thinking insects capable of controlling their emergence, so as to appear at a season convenient to themselves, which assumes, we think, a far greater amount of intelligence in the chrysalids, than in the collectors.

Surely this is the time when our head Entomological Society should put itself into communication with those abroad, to enquire whence and when this migration took place. Where was edusa in super-abundance in the year, 1891? Where in the spring of 1892? Was there any

sudden cessation in their numbers, and when, and what direction was the wind at the time? These and other questions, if duly answered, would be worth all the records put together of the places where this butterfly has been noticed.—Eds.

Chalk Sections.—As a ready mode of making chalk sections thin enough to be translucent, I cut a chalk section about $\frac{1}{20}$ of an inch. Treat it with dilute acid, by preference, dilute acetic. This is to remove all loose chalk. Wash and dry it thoroughly. Cement to a glass slip with Canada Balsam. Pare it down with a sharp knife and then develop it like a photographic plate with dilute acid and a camel's-hair brush until it appears translucent. It may then be finished in the usual way with Canada Balsam and a cover glass.—McD.

Change of Title.—There is always some risk attached to a change of name; but it has been forced upon the Dover Field Club, through their title having been adopted by a betting agency, and the consequent disagreeables which have arisen from the confusion. Our Dover friends have availed themselves of the opportunity to further enlarge the scope of their enquiries, and for the future the club will be known as the Dover Natural History and Antiquarian Society.

Perennial Wasp's Nest.—In part II we mentioned a wasp's nest which had been occupied for three years in succession by presumably members of the same colony; upon visiting the spot in 1891 no trace of it was visible, but this is not surprising as the bank had been smoothed down and returfed. The only wonder is that it was allowed to remain so long undisturbed, being situated close to an orchard and cottage fronting upon a public highway, yet we feel sorry we cannot carry the observations any further.—S.W.

British Sardines.—In January, 1892, considerable numbers of sprats netted close to the pier head were hawked about the streets of Dover. About twenty of the skeletons were handed me for extracting the otoliths, and whilst doing so I noticed that two of the skulls were inordinately long, and the otoliths from them quite different from the others. Comparing them with some I had obtained previously from Mediterranean sardines, I found them to agree in every particular. Unfortunately the partakers had not noticed any differences between the fishes, so I am unable to say whether a mixed haul of sardines and sprats had been taken by the fishermen, or whether a few strays from the south had joined the sprat shoal. From the fact that a Dover sprat is generally of much larger size in January than were these specimens, I am inclined to think the shoal was passing from an unusual direction and had been joined by some of the rarer species. Mr. Horsnaill who has studied the fishes of our rock pools, tells me he recognized a difference between individual fishes from the hauls in January, but the thought of sardines did not at the moment occur to him and he omitted to examine them more closely.

The true sardine is so rare in our waters that by many ichthyologists it is excluded from the British Lists.—S. Webb.

LANDSLIP NEAR FOLKESTONE!

BY WHICH TWO PERSONS LOST THEIR LIVES.

21st January, 1891.

[*Short address given on the ground by Captain McDakin, when acting as guide to a party of the D.N.H. and E.K.N.H. Societies.*]

SUCH was the heading of a report printed in the local papers of the time.

On visiting the place a few days after the catastrophe, it appeared to have been caused by a sudden rush of water from the slopes above. The landslip having been a secondary cause.

The exact spot is indicated on the Ordnance contour map by two black dots, representing houses, that to west close to the elevation number 369, and north of a farm named Danton Pinch is, or rather was, the cottage that on Wednesday morning, the 21st January, 1891, was overwhelmed and swept across the carriage road by the sudden thawing of a mass of snow that had accumulated on the top of the chalk escarpment, about 150ft. above it, and 500ft. above sea level.

The water first flowed into a coombe at the top, sloping down from north to south, with an angle of 20° for 80 yards, and a width at its gorge of 55 yards.

For about 70 yards farther it ran over a slope of 30°, until it reached an old fall having an angle of 40° degrees, rushing down this it tore out a mass of rubbly chalk, and pouring again over a lower slope of 30° fell upon the house, sweeping it over the road into a field below, carrying the straw roof a distance of 60 yards. It was in this roof that the three children were miraculously preserved, bundled over and over down a steep slope for 30ft., and in this way carried 60 yards. The boy of ten years of age, William Hayward, was awoke by the water running over his face, and behaved in a brave and ready witted manner in rescuing his little sister of eight and baby brother of under two years of age.

The father and mother, Hayward and his wife, with their infant four months old, were killed by the fall of the brick and timber portion of the building ; the wreck of which was scattered over the field below in a confused heap, with many tons of loose earth. Only the brick foundations remained where the house stood, which was a one-storied brick and thatch structure.

An unfortunate sheep that had sought shelter from the storm was found dead under the ruins. Sergeant Hood of the County Constabulary, who was one of the search party early the same morning, stated that a live sheep jumped out and ran away.

George Mount, living in the cottage to the eastward, about a furlong off, and who gave shelter to the children, stated that the water ran down the hill like a waterfall, making a great noise. For some weeks after the track of the water was very evident, the loamy beds on the top of the chalk, and the rubble of a much older fall, overgrown with grass, having been carried down by the rush of water, which could be traced as far as Danton Pinch, a farm half-a-mile below.

During the late severe winter many small lakes might have been observed on the surface of the frozen chalk, which under ordinary temperatures is far too porous to allow water to collect on its surface. This condition of things was a remarkable confirmation of the theory which, if it did not originate with, has had the sanction of G. Dowker, F.G.S., and Clement Reid, F.G.S., that the valleys of the chalk were formed under similar conditions, longer continued, at the close of the Glacial Period.

The dry ditch under the ancient city walls of Canterbury was through the same cause filled with water, which under ordinary circumstances can never be the case, owing to the porous nature of the soil.

The picturesque valley in which Maydeacon and Broome Hall stand was in a similar manner flooded to such an extent that a valuable stud of hunters was nearly drowned.

In connection with the same subject, it is of interest to remark that the slopes of the hills and sides of the coombes seldom exceed 30°, and I have never found any exceeding 40°, except in the neighbourhood of the fortifications where they have been artificially scarped.

These angles of slope were taken with a clinometer, having parallel bars two feet and a half in length.

Coombe down which the water rushed upon the house, which stood close to the road, and vertically under the clump of trees on the top of the hill, looking north.

VOL. I. PART IV.

THE

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THE TRANSACTIONS

OF THE

Associated Natural History Societies

OF THE

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PAPERS AND NOTES

BY THE MEMBERS OF THE

East Kent Natural History Society, and of the Dover Natural History and Antiquarian Society.

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TRANSACTIONS.

XXVI.

REPORTS OF LOCAL SUB-COMMITTEES, INSTITUTED AT THE REQUEST OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE;

TO OBSERVE AND REPORT UPON;

I.—*The extinction and disappearance of rare Plants, and the introduction and spread of others.*

II.—*Earliest dates of Plants flowering.*

III.—*Life histories of Plants.*

IV.—*Coast erosion.*

I.—*The extinction and disappearance of rare plants, and the introduction and spread of others.*

Mr. Dowker, who has studied the botany of East Kent, and recorded his observations upon it for about thirty years, has supplied the greater part of the following notes.

CRUCIFERÆ: *Cardamine amara*—once abundant on the banks of the Stour, is now much less frequently met with.

Erysimum cheiranthoides—still blooms in abundance at Elmstone.

Sisymbrium sophia—is scarce.

Lepidium draba—has increased vastly in all the eastern part of the district.

Lepidium latifolia—is exterminated from its old spot near Sandwich.

CARYOPHYLLACEÆ: *Dianthus armeria*—is not nearly so frequently seen in its old localities.

Saponaria officinalis—is still abundant in its old habitat, Ash Street, in spite of efforts made to exterminate it.

Silene nutans—the Dover variety is still abundant on the cliffs; a dwarf variety occurs on Lydd beach.

Silene noctiflora—as a corn-field weed is not as frequent as formerly.

Silene dichotoma—found in a field in the parish of Wingham, is *new* to Kent. It is a native of south-eastern Europe, and has not been recorded before.

GERANICEÆ: *Geranium lucidum*—mentioned as an East Kent plant, has not been noticed by Mr. Dowker.

Geranium striatum—a garden escape, seems naturalized at Waltham and elsewhere.

Genista anglica—a rare plant in East Kent, is reported to be diminished in one of its localities.

ROSACEÆ: *Potentilla comarum*—is still abundant in the ponds of Lydd beach; it has not been found elsewhere in East Kent.

SAXIFRAGACEÆ: *Chrysosplenium alternifolia*—is now rare in Kent.

HALORAGIACEÆ: *Callitriche autumnalis*—is found in ditches at Lydd, and thereabouts, but not elsewhere.

ONAGRACEÆ: *Epilobium Lamoyi; alsinefolium; and obscurum* have all been found by Rev. E. S. Marshall in the neighbourhood of Stourmouth, but it is only of late that these sub-species have received attention.

CRASSULACEÆ: *Cotyledon umbilicus*—has been growing for many years on Goodnestone Church, near Wingham (G.D.) It is also well established on an old flint wall of a farm house at Chilham (W. H. Hammond).

UMBELLIFERÆ: *Eryngium campestre*—a few years ago existed on the sand dunes near Romney, it has, however, now disappeared, entirely through man's agency and modern improvements. (S.W.)

Bupleurum tenuissimum—is still to be found in abundance in its old habitat.

Cicuta virosa—has been recorded as an East Kent plant, but we have no knowledge of recent finds.

Amni majus—(an introduced European.) Mr. Dowker found some two or three years in succession near Sandwich, but it has now disappeared.

Falcaria riveri—the same gentleman has known it for more than thirty years in the parish of Preston, near Wingham, where it is established in some arable fields, remote from any dwelling. (See Journal of Botany).

Œnanthe lachenalia—is still abundant near Sandwich.

Peucedanum officinale—it is very remarkable that this plant, which grows in such profusion between Whitstable and Swalecliffe, where it has been established for so many years, should not have extended to other parts, where soil and situation seem equally suitable.

CAPRIFOLIACEÆ: *Sambucus ebulus*—has disappeared from many of its old localities, though this rare plant may occasionally be still met with.

DIPSACEÆ: *Dipsacus pilosus*—seems to appear at intervals near its old haunts, but never in abundance. Mr. Dowker has also met with it from time to time at Old Park, Canterbury.

COMPOSITÆ: *Petasites vulgaris*—is mostly seen as a garden escape, but at Sheerwater, near Elmstone, it grows in an undoubted wild state in giant proportions, along with *Equisetum fluviatile*, the latter not at all common elsewhere in East Kent.

Lactuca saligna—is not only found in its old locality at Swalecliffe, but has extended to Whitstable and Seasalter.

CAMPANULACEÆ: *Campanula hybrida*—does not seem to have extended far from its old localities.

ERICACEÆ: *Pyrola rotundifolia*—a rare plant, is nevertheless tolerably abundant in its old habitats.

CONVOLVULACEÆ: *Cuscuta epithymum*—this plant is subject to great variation, the smaller variety is ofttimes a very troublesome parasite on clover, where it is known by the name of "Hell weed." On the beach at Lydd a larger variety is found on *Stachys sylvatica*, and other plants.

SCROPHULARIACEÆ: *Verbascum blattaria*—from time to time has been found in clover fields, in most cases probably introduced with foreign seeds.

Scrophularia vernalis—a few specimens of this plant are found about the precincts of St. Augustine's Monastery, Canterbury, and have been known there for forty years at least, but have not been met with elsewhere.

OROBANCHACEÆ: *Orobanche major* on broom, and *minor* on clover, are both common in Kent.

O. caryophyllacea, and *cærulea*—have both been met with from the Warren, Folkestone, to the Sandhills, Sandwich, but the distinction between the two seems to rest with the opinion of the finder.

LABIATÆ: *Ajuga chamæpitys*—is a very local plant, and not common in E. Kent, it used to be found in a field called "Crow-hop," at Knowlton, near the Park, and at Chilham.

CHENOPODIACEÆ: *Atriplex pedunculata*—a rare plant, is still found near the Saltpans, Sandwich.

Salicornia—in most of its species and varieties are also found there.

Suæda fructicosa—said to grow in the same place has not been found.

POLYGONACEÆ: *Polygonum bistorta*—is not common, and has quite disappeared from some of its old localities.

ORCHIDACEÆ: The Orchids of E. Kent deserve to be considered with more detail. Some of the species mentioned by the older botanists have not been noticed for many years in the places where they were formerly said to have been met with, as for instance *Malaxis paludosa* in Romney Marsh; *Liparis loeselii* in Ham Ponds; these may have been overlooked, but it must be remembered that better drainage may have had much to do

with their disappearance. In Ham Marshes they might still be expected to appear, but Mr. Dowker has never found either, or heard of any one that had done so.

Epipactis latifolia—is tolerably abundant still, and also the sub-species *purpurata*.

Epipactis palustris—is not nearly so common as formerly in the Wingham Marshes, or elsewhere.

Cephalanthera grandiflora—is common; but *ensifolia* and *rubra* Mr. Dowker has never found.

Orchis fusca—the usual Kent form now called *purpurea* is not nearly so common as formerly. It seems prone to go to varieties, but none of these assume the form of *Orchis militaris* proper, and Mr. Dowker could never satisfy himself therefore that this orchis existed in E. Kent.

Orchis hircina—has never been met with of late years.*

Aceras anthropophora—is not nearly so frequent as formerly.

Ophrys apifera—seems on the road to extinction from the plant vendors digging it up wholesale.

Ophrys arachnites—is now very rare.

Ophrys aranifera—appears also much less frequently than formerly.

Ophrys muscifera—the same may be said of this.

Herminium monorchis—many of the chalk downs have been broken up where it formerly grew.

Habenaria viridis—the same may be said of this.

Hydrocharidaceæ: *Elodœa canadensis*—first noticed in E. Kent in 1864, see letter to "Kentish Gazette," Oct. 18th of that year. It increased with enormous rapidity, but is not so rank growing as formerly, and appears upon the decrease.

Typhaceæ: *Sparganium simplex*—the long floating variety is common in the Stour, where, however, it is seldom allowed to bloom.

Passing on to Grasses it may be said there seem to be a few new introductions, as for example:

Setaria viridis—near Sandwich.†

Filices: *Ceterach officinarum*—was formerly growing on Eastry Church, and on the walls of Old Park, near Canterbury, although it can hardly be considered a Kentish fern.

Lastrea oreopteris—grew on the bog, Mersham Hatch. It is not usually a Kentish fern.

Osmunda regalis—grew plentifully in Chartham Hatch and Perry Woods, but it is now quite exterminated.

G. DOWKER.
J. REID.

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* See Note on Rare Plants. S.E. Naturalist, part II. p. 60. Eds.

† And see others mentioned, last reference note. Eds.

Among the plants met with on excursions this season were the following:—

The initial numbers are taken from the pages of Bentham's British Flora.

Dover South Pier.

132 Spergularia marina
S. rubra

St. Radigund's.

1047 Asplenium ruta muraria
1055 Ceterach officinarum
1047 Asplenium trichomanes
353 Angelica sylvestris

Deal and Sandwich.

198 Trifolium arvense
436 Artemisia maritima
100 Frankenia lævis
877 Juncus acutus
192 Medicago minima
297 Sedum acre
117 Sagina nodosa
1037 Polypogon monopeliensis
342 Ænanthe lachenalii
341 Bupleurum tenuissimum
444 Filago (Gnaphalium) minima
416 Erigeron acris
415 Aster tripolium
322 Hydrocotyle vulgaris
324 Eryngium maritimum
544 Glaux maritima
692 Suæda maritima
61R Salicornia herbacea
702R Obione (Atriplex) pedunculata

Deal Sandhill, and near Sandwich.

693 Salsola Kali
168 Erodium cicutarium

Barham.

808 Epipactis latifolia
810 Cephalanthera grandiflora
512 Campanula trachelium

The Warren.

649 Mentha pulegium
679 Armeria maritima
723 Hippophæ rhamnoides
159 Geranium pratense

Newington.

920 Carex pendula

Ewell Minnis.

460 Carduus tuberosus (variety)

Kearsney (Well).

Crypto Batrachospermum.

S. GORDON McDAKIN.

II.—*Earliest dates of Plants Flowering.*

An interesting report on this section has been sent in by Mr. F. C. Campbell, but it is withheld for the present as incomplete.

III.—*Plant-Life.*

In connection with the subject of Plant-Life a communication has been received on the *Seed produce* of a plant of *Malva moschata*, as follows:—

The specimen taken was growing in the natural turf of a garden recently formed out of a pasture. This pasture-land was over-lying a formation of Mountain Limestone.

The Flower-heads examined grew from a common stem and formed branched clusters springing from the axils of the upper leaves of the stem. The clusters were semispherical, varying

from 14 to 17 flower-heads in the group. An extra, solitary, flower-head appeared in the axil of a small leaf placed below on the supporting branch of two of the clusters; these were excluded from the reckoning as imperfect in development. A small terminal group of three heads which surmounted the three main clusters was estimated as a fourth cluster. Two of the main clusters presented 14 heads, and the third 17 heads, three of these heads appeared to be additional heads separated somewhat from the rest, and might almost have been considered a terminal group to the other heads of the cluster, as the 4th cluster was estimated in relation to the three main clusters.

The three bracts surrounding the Calyx, and the Calyx itself, showed the brownish tint of withering, and the capsules within were blackish, separating easily from their adhesion to the projecting axis in all three of the main clusters of flower-heads. It was particularly noticed how the five divisions of Calyx (Sepals) had contracted down on the axis and its encircling ring of the seed-holding capsules acting as a protection to the maturing seeds after the fall of the petals, &c. The points of the Sepals all met in the centre and pointed upwards. Some of the Sepals were split on the edge so as to produce a minute lateral Sepal, or in other instances the division went deeper into the encircling ring of the Calyx and produced a sixth complete Sepal or division of the edge of the Calyx. It was noted that, generally, three capsules of the circlet were opposed to each Sepal; this estimate would give 15 capsules as the normal amount within each Calyx, but it was found that the number varied from 14 to 18, it was therefore thought expedient to observe the relation of the divisions of the Calyx, or in other words its amplitude, to the number of capsules. However, a definite result was not obtained. The number of Seeds in each capsule were not reckoned, and as the number is sometimes more than one the total amount of *Seeds* given may be considered to exceed that which is enumerated. Every capsule that was not plump and firm was considered imperfect and immature. The capsules were examined in due order from the lower to the upper part of the stem, and the flower-heads in groups of four or less from without inwards.

No. 1 Cluster of 14 flower-heads, excluding a minute abortive head a mere bud in centre yielded a *total* No. of capsules 224, of which 10 were imperfect, leaving 214 perfect ones.

No. 2 of 14 flower-heads smaller than those of No. 1, seven especially so	219	,,	19	,,	,,	200	,,
No. 3, 17 heads, three grouped as a terminal cluster	237	,,	12	,,	,,	225	,,
No. 4, 3 heads, a small terminal cluster of the stem, five seeds not ripe	14	,,	4	,,	,,	10	,,
52 flower-heads yielded capsules	694 Total.		45 were imperfect.			649 perfect.	

J. REID.

CHEMISTRY AS A HELP TO AGRICULTURE.

Extract from the "Kent Herald," Oct. 25, 1894.

At the opening meeting of the Winter session of the East Kent Natural History Society at Watling Chambers, Canterbury, the President, Mr. Sidney Harvey, gave a very interesting and suggestive address on "Chemistry as applied to Agriculture." It is of such value that we give a full report of it.

Mr. Harvey said,—After hearing the able report of the delegate from our society to the British Association, and his suggestions, it will be setting a good example if I select a local subject, viz., one having reference to agriculture and the more so because the Kent County Council have for some years past offered every encouragement, both by means of lectures in the various villages and also by practical and extensive experiments carried on by skilled advisers at certain farms in the district, in order to facilitate and push forward scientific agriculture. Moreover the Wye College where pupils will be trained in every branch of this subject, approaches completion, and this building, in which the present meeting is assembled, is and has been employed for chemical researches having the same object in view and is filled week by week by classes of earnest students making excellent use of the facilities provided by the County Council who are worthily following the leadership of Messrs. Lawes and Gilbert at the world-famed experimental farms at Rothamsted, where for many years the most extensive experiments in every conceivable branch of Agriculture has been conducted with princely munificence. It is much to be hoped that this energetic commencement in this county will not be suffered to flag in the face of the existing depression and discouragement

and that the splendid examples set by Rothamsted and by the United States of America, under which latter Government "state laboratories" liberally endowed and appointed have for years yielded a rich harvest of results of the greatest value, will be followed and if possible emulated. Ever since the time of Sir Humphrey Davy and Baron Liebig the importance of chemistry to agriculture has been recognised and the knowledge of how the plant in contradistinction to the animal, (which must derive nourishment exclusively from something which has lived previously) exists, grows and developes indefinitely upon lifeless material only has assumed the greatest importance. The plant obtains its food from two sources; the limitless magazine afforded by the atmosphere and the moisture therein on the one hand and the mineral matters, equally essential, placed at its disposal by the soil. In short, plant life starts upon a totally inorganic food. The surface of a country may be both rocky and bare, but, sooner or later, the lower organised plants—that is the more simply organised, not lower in any other sense—such as the mosses will settle upon the unpromising surface and having the atmosphere at disposal and getting sufficient mineral matter, even from a hard rock, will maintain themselves and thrive. This they will do to such an extent that in course of time they cover the surface and dying give place to flowering plants until, eventually, these are succeeded by even forest trees themselves. The rapid development of vegetable life already apparent upon the fire scathed ruins of Krakatoa, in Java, so lately the scene of one of the greatest of recorded eruptions is a fine instance in point There is a certain resemblance between plants and animals deserving notice here. Among civilised humanity for example, there are two types of man, viz., those who live so to speak on sixpence a day and earn it, and those who have their food found for them, cooked and served up for them. The former get stronger by active labour

and exercise and very likely keep their normal weight year after year ; the latter possibly grow in weight through getting fat and idle. Two such types exist among plants. How often is one struck by the beauty and perfect health, vigour and the regular advent of the wild flowers by the wayside, often exposed to inconsiderate violence and always to neglect, without any attention save an unfavourable one from man and without manure or extra nutriment, they year by year, century by century, in the old spots, sturdily maintain their peculiar " habit " of growth and yield seed after their kind. On the other hand the cultivated plant has certain demands put upon it. Its flowers or fruit must be abnormally developed with all the accessories of perfume and luscious flavour, or food producing power. To accomplish all this external aid and attention must be called in and the power of such plants to obtain their own nourishment must be supplemented by manures artificially applied and here the sciences of Horticulture and Agriculture step in. The artificial aid thus rendered enables the growing plant to transfer some of the energy, hitherto devoted to extracting and searching for food together with the delay so involved, to special development, modification, or increase, in fact it becomes a question *of saving of time.* When in 1840 Liebig, by his lectures, drew attention to important facts, hitherto too much ignored, that while plants during growth accumulated and re-arranged the elements entering into their composition ; they *created nothing* and that while the surrounding atmosphere might be relied upon to furnish the chief *organic* constituents, the *mineral* material was all important and its abstraction from the soil left the latter so much the poorer while the absence or insufficiency of the same meant hopeless sterility. Astonishing as has been the progress of chemistry since Liebig's time his " Chemistry applied to Agriculture " is still a classic work and must remain so despite the fact that many of its conclusions are super-

seded by the march of discovery, and the greatest pleasure and profit may still be derived from its study. Of course this great teacher was grossly misunderstood and misrepresented and he is not responsible for the sanguine and enthusiastic expectations indulged in by many who looked forward to two or three crops in the season. More sober views ultimately prevailed and farmers perceived that they had still to deal with uncertain meteorological conditions and that unceasing labour and toil was the lot of all engaged in providing food for man and beast. As one of the most obvious directions of inquiry was involved in the condition and composition of the soil, the aid of the chemist was systematically employed and analysis resorted to in order to ascertain possible mineral and organic deficiencies. The results thus obtained were often of the greatest value, especially in cases where the practical absence of all-important constituents was revealed. But in many instances the chemist, after furnishing results of his work, was unable to speak with certainty as to the bearing of these results upon the suitability of the soil examined for the growth of special crops, while in other cases soils *unfavourably* reported upon by analysts were *known* by their owners to yield fine crops, and this is especially applicable to some lands in Thanet famous for barley. Matters went on thus for years and samples of soils continued to be analysed and doubtless the total amount of their essential principles estimated more or less correctly. During the past ten years this inquiry has undergone a "change of front" and a new departure inaugurated which will probaby prove critical as regards future agriculture. The question has been latterly put something like this—confining the inquiry to Potash and Phosphoric acid (for the present as a starting point) these principles being of prime importance to every food-yielding plant, how do such plants get these principles from the soil? Do they secrete any

solvent by means of which their rootlets attack successfully the mineral masses of which the soil consists ? If so what are the nature and properties of this solvent ? Can such solvents be artificially imitated and can an adequate amount of such solvent so imitated be applied to a known quantity of soil in question for a due time and the solvent thus applied be subsequently examined to see whether the two principles above adverted to have been extracted therefrom and *to what extent?* How do these amounts tally with the past yield and fertility or otherwise of the soil operated upon ? This investigation, which has been quietly but energetically proceeding for some years, has been answered and has culminated in a most important paper by Dr. Bernard Dyer, read before the Chemical Society in February last and may be very briefly summed up thus :—The solvent in question is root sap present in the rootlets. The result of analysis of more than 100 different varieties of cultivated plants show that this rootsap is acid and, although varying within tolerably wide limits in the numerous varieties examined, may for practical purposes be fairly represented by a one per cent. solution of citric acid ; an acid very extensively present in plants, as shown by its recent discovery in milk. That when a known amount of soil is agitated with a certain quantity of the artificial sap juice, and for a definite and sufficient time and the separated juice analysed for potash and phosphoric acid there is *a close agreement between their amounts and the known fertility, or otherwise of such soil.* Above a certain figure fertility is implied, below that amount the reverse. One of the first fields experimented upon was the famous Hoosfield at Rothamsted on which barley crops have been grown for 40 years in succession and of which previous records have always been preserved. By the permission of Sir Henry Gilbert and Sir John Lawes more than 20 samples from as many plots in this field were subjected to this new treatment and with corroborative results not to mention numer-

animal and vegetable world for our food, our medicine, our dyes, our clothing, our fuel, as well as for the luxuries of life generally. All this is however undergoing a change. Our fuel is now mostly of mineral origin and the same may be said to a large extent of our medicine and our dyes. Our food still comes from the old sources, but the rapid sequence of the artifical manufacture of food principles needs little but the production of the proteids or albuminoids, to make the chain complete. The synthesis of these latter are still in the future, but when accomplished, as many competent to judge believe will be the case, the *artificial production of food* itself in its totality is only a question of time and points as one consequence to the *disuse of the soil* for the growth of food. In the interests of a depressed state of agriculture, let us hope that this event is in the far distant future and that its development will be as gradual in the future as it has been in the past, and that when the full time of its accomplishment has arrived the earth may at least be spared to yield its treasures of trees and flowers and that " the desert may yet rejoice and blossom as the rose."

IV.—*Coast Erosion.*

The coast line from St. Margaret's Bay to Folkestone has been compared with the six inch ordnance map of 1876, since which date there has not been any noticeable loss of land, but only the heavy falls previously mentioned.

At 24 principal, and 11 intermediate stations, holes have been drilled in the chalk on the plane of marine erosion; these are half inch holes, three inches deep, having a different arrangement for each year thus :—

1890. 1891. 1892. 1893.

The hole with the circle round it is the test hole, the others are only indicating marks.

This form of mark was chosen as not being easily imitated or tampered with. The average erosion of four years has not been more than half an inch, and this is somewhat surprising as the chalk, with the exception of the hard nodular beds, cannot be considered a hard rock, but it possesses a toughness that renders the boring of these half inch holes with a brace of five inches radius, a considerable exertion. The great falls seem to be caused by the springs sapping the foundations, the sea afterward carrying away the fallen blocks.

Some years ago a careful investigation was made of these springs in connection with schemes of water supply when *two hundred* of considerable volume were stated to issue out of the base of the cliffs between Folkestone and the South Foreland.

S. GORDON McDAKIN.

XXVII.

CHEMISTRY OF DOVER WATER.

BY

W. H. PENDLEBURY, Esq., M.A. (Oxon.) F.C.S.

In these days of general enlightenment it is hardly necessary to insist upon the importance of a pure water supply, since almost everyone is aware that the health and well-being of every community depends, in great measure, upon its having pure air and pure water. The object of my paper is to indicate what impurities are present in the Dover water supply, and to show experimentally how the impurities may be detected, and, if necessary, removed. I must ask you to disabuse your minds of the idea that the word "impurity" necessarily implies the presence of a harmful substance. Absolutely pure water is a compound of the two gases

oxygen and hydrogen, but from its property of readily dissolving most of the solids and gases it comes in contact with, pure water does not exist out of the chemical laboratory.

The purest form of water we meet in nature is the rain as it falls, but even here it is dissolving, in its fall, the gases out of the atmosphere; and as soon as it reaches the ground and spreads itself on the surface it takes into solution many impurities.

As the ultimate source of our water supply is the rainfall, it will be of interest just to glance at the meteorological condition of Dover. I must here acknowledge my indebtedness to Mr. W. Thomas, C.E., the Borough Surveyor. If we first take the prevailing winds which bring us our clouds, we shall be able to consider our water supply "ab initio."

Table shewing the number of days each wind prevailed :—

	1892.	1893.		1892.	1893.
North East ..	99	118	South ..	5	2
North West ..	164	171	East	22	16
North ..	25	21	West	51	37

We may also remark that in 1893 there were 189 clear days, 27 foggy days, and 149 overcast.

The next table gives the rainfall for the last two years :—

	1892.	1893.
January	·84	1·41
February ..	3·57	3·19
March	2·00	·55
April	1·10	·05
May	·50	2·70
June	2.78	2·67
July	1·44	3·84
August	5·19	2·01
September ..	2·85	5·92
October	7·06	3·60
November ..	3·80	4.34
December ..	2·5	2·23
	33·63 inches.	32·51 inches.

Taking the mean of the two years we shall find that 33·07 inches of rain fell annually in Dover. An "inch" of rainfall means of course, that if the rain which fell did not sink into the ground, or evaporate, it would form a pool of that depth over the area indicated. Therefore the rainfall of Dover would represent a pond 33 inches deep covering the whole of Dover. The weight of this quantity of water would be immense, for one inch of rain means 100 tons of water to the acre.

Now of this 3,307 tons of water which falls annually on each acre in the Dover district, part is evaporated, part flows away directly into the various streams, and part sinks into the ground and helps to form the immense reservoir of water which is contained in the chalk beds of this part of Kent. This reservoir is tapped by various wells, and empties itself at the numerous springs which exist wherever the saturated chalk is in contact with impervious strata suitably inclined. It may surprise many of my hearers to learn that there are over 20 streams flowing down from underneath the chalk cliffs between Dover and St. Margaret's Bay. Some of these discharge large volumes of water. One, at St. Margaret's Bay, itself dicharges 2,750,000 gallons per day into the sea, one at the part of the cliffs known as Frenchman's Fall discharges one and a half million gallons per day, and one at the Convict Station pours away into the sea over a million gallons. Thus three of the springs out of the twenty discharge over five and a half million gallons of water per day. The spring at Lydden Spout discharges over four million gallons daily. There is therefore running to waste along three or four miles of the neighbouring coast, more water in a day than would suffice for the whole of Dover for a week. The recent Parliamentary Commission on the water supply of the Metropolis, turned its attention to these springs, as a possible future source of water supply for London.

The depth of the well at the pumping station at Castle Knowl, Dover, is 220 feet, and, on the average, six and three-quarter million gallons are pumped up each week with the average consumption of nine and a half tons of coal. The water is clear and palatable, and not excessively hard. I shall now give you three or four Tables embodying the analytical results of several eminent chemists. They are perhaps somewhat confusing, as the results are given in different forms, and they exemplify the crying need of some understanding amongst analysts as to the best method of stating the results of water analysis.

The first analysis is that of Dr. Letheby. He found in an imperial gallon (70,000 grains) of Dover water the following :—

TABLE I.

	Grains.
Total Solids	22·01
Carbonates of Lime and Magnesia ..	13·75
Sulphates of Lime and Magnesia ..	2·42
Sodium Chloride	·92
Sodium Nitrate	4·25
Silica and Alumina	·67
Organic Matter	0
Hardness before boiling	17°
,, after boiling	$6\frac{1}{2}$°

About ten years afterwards Dr. Wigner published, in the "Sanitary Record," the results of analyses of the water supplies of various health resorts, that of the Dover water appeared in September, 1877. It was as follows :—

Table II.

	Grains.
Total Solid Matter	22·90
Loss on ignition..	3·08
Common Salt (Chloride of Sodium)..	2·81
Nitrogen as Ammonia	·0018
Nitrogen of Albuminoid Ammonia ..	·0024
Nitrogen of Nitrates	·139
Nitrogen of Nitrites	·001
Total Nitrogen	·1442
Oxygen absorbed by Organic Matter	·011
Hardness before boiling	15°
,, after boiling	3°

The next Table to which I shall draw your attention, embodies the results Dr. Glaister obtained last year. He states his results in parts per 100,000, but I have reduced them to grains per gallon, for the sake of comparison with the others :—

Table III.

	Grains.
Total Solid Impurity	20·72
Previous Sewage or Animal Contamination	2·95
Chloride of Sodium	3·00
Organic Carbon	·024
Organic Nitrogen	·006
Ammonia	·0007
Nitrogen as Nitrates and Nitrites ..	·3164
Total Nitrogen	·3231
Hardness before boiling	16°·52
,, after boiling	3°·5

Now having had your attention drawn to the results of these analyses you will easily understand the bearing of what follows on this subject.

When the comparatively pure water falling as rain reaches the ground, it comes in contact with decaying vegetable and animal matter. If there is much of the latter the water takes up the products of its decay and becomes rich in Nitrogen compounds, that is to say, Nitrates, Nitrites and Ammonia. Water, therefore, which contains large quantities of these bodies is, generally speak-

ing, harmful and unfit for use. The presence of large quantities of common salt may also indicate animal contamination, but this is only to be taken as a guide when it occurs with excess of Nitrogen compounds, for, though the amount of common salt (or Sodium Chloride) is somewhat above the average in the Dover water, this must be ascribed to our proximity to the sea, whence it sometimes happens that infiltration of sea water into the chalk reservoirs takes place, and also the salt spray is mechanically carried over the land, and the salt is dissolved by the next shower of rain.

By means of a standard solution of silver nitrate I will shew you the method of determining the amount of chlorides in drinking water. The method depends upon the fact, that though silver nitrate produces a reddish brown precipitate with chromate of potash, this precipitate does not appear in the presence of a chloride till all the latter has been thrown down as silver chloride. Then the next drop of silver nitrate solution produces a reddish tinge. We shall find one result gives a little over three grains of salt per gallon. This agrees very fairly with the results of Drs. Wigner and Glaister. The result of Dr. Letheby is evidently too low, but the amount of salt varies considerably with the amount of rainfall.

We will now discuss the effect produced on the rain water by its coming in contact with decaying vegetable matter. As we know, the element carbon is the essential constituent of vegetable matter, and hence, in decaying, carbonic acid gas is produced. This gas is soluble to a large extent in water, and so the rain water absorbs it. Water containing carbonic acid in solution acquires the property of being able to dissolve chalk, forming with it a bicarbonate of lime. Chalk does not dissolve in water free from carbonic acid to any appreciable extent. Water containing chalk in solution is perfectly clear to look at, but as soon as the carbonic acid gas is got rid of, either by boiling, or by removing it in some other way, the chalk, being unable to remain in solution without the presence of carbonic acid gas, is precipitated. Hence the "fur" in kettles and hot water pipes which causes grave inconveniences to householders. Such water, from the difficulty of getting a lather with soap when it is used for washing purposes, is called "hard water"; but as the water can be softened by boiling, as above indicated, it is called "temporary hard water" to distinguish it from the water containing Sulphate of Lime (Plaster of Paris) or Sulphate of Magnesia (Epsom Salts) in solution. Water in the Trent district is hard from the presence of these salts and is not softened by boiling. Such water is known as permanently hard water. In the Dover water we have some 12° or thereabouts of temporary hardness, that is 12 grains of chalk per gallon and 3° or so of hardness due to the presence of these sulphates. This

is the meaning of the distinction between hardness before and after boiling in our Tables, the former being the total hardness and the latter the permanent hardness.

I will now shew you how the hardness of water is estimated. The operation consists in the careful addition, from a measuring tube known as a burette, to a known measure of water, of a solution of soap in alcohol. The water is placed in a stoppered bottle and shaken after each addition of the soap solution. At first you will see no lather is formed, but only a curd. We must continue the addition of the soap till a permanent lather is formed on shaking, which lasts and does not disappear for two or three minutes. We then read off from our burette the quantity of soap solution we have taken. This solution has been made up to a certain strength so that each measure of it corresponds to a known quantity of chalk. We can tell at once therefore how much chalk there exists in solution in the quantity of water taken, and, by simple calculation, how much in a gallon.

Let us now consider what happens when we try to make a lather with soap and hard water, and we only succeed in obtaining a curdy substance. Soap is a compound of sodium with stearic, palmitic, and oleic acids, and is soluble in water, but when we bring this sodium compound (soap) into hard water, the lime existing in the chalk replaces the sodium, and forms a "lime soap," which is insoluble in water; hence we cannot obtain a lather till we have got rid of all our lime at the expense of our soap. Thus hard water is really an expensive luxury, for we have to soften it with soap before the soap can be used for its proper purpose. It is no wonder, therefore, that many schemes have been proposed for softening temporary hard water. We have seen that boiling the water brings about this result, but coals are dear! There is a much simpler process which depends upon the well-known fact that lime water is precipitated by carbonic acid with the production of chalk, so that if we were to add to temporary hard water the right quantity of lime water for precipitation, we should get rid of our hardness, and save our soap. This process is carried out practically at the Canterbury water works, and is the means of saving, as we shall see, money to the inhabitants. It may be remarked that one glassful of lime water (made by putting a few lumps of fresh quick-lime in a bucket of water and allowing it to stand for some time), is sufficient to soften eight glassfuls of Dover water.

If we compare the cost of softening water by these various processes we shall obtain some interesting results.

Suppose we took as much water as would require 1 cwt. of lime to soften it, and softened it by boiling, and added in the

cost of the coals; and if we also softened the same quantity with carbonate of soda (washing soda) and again a similar quantity with soap and then compared the cost we should find :—

	£	s.	d.
1 cwt. of lime costs, say	0	0	8
$4\frac{3}{4}$ cwt. carbonate of soda	2	17	9
$20\frac{1}{4}$ cwt. of soap	47	1	8

(The above calculation is given in one of the Reports of the Royal Commission on water supply).

We may put the matter in another way however. If we suppose that three millions of gallons of the total weekly supply of water is used in Dover for washing purposes, the value of the soap wasted in producing useless curd with it is over £510, which is about *four-pence per head of the population.*

There are certain drawbacks to the use of very soft water. It is said to produce "rickets" in children owing to insufficiency of lime for bone formation. The gravest defect, however, is that soft water attacks leaden pipes, whence cases of lead poisoning are by no means rare where the water is very soft.

There is one part of water analysis which I have not touched upon, but which is now attracting great attention. That is the bacteriological examination of water. A specimen of water might pass a splendid chemical examination, and yet be a deadly draught, owing to its containing bacteria which almost entirely escape chemical tests. But where there is an efficient system of filtration through sand, especially when the filtering beds have been so long in use as to become covered with a slime of bacteria there is little danger. It is a curious fact, but it certainly seems proved to be the case, that the older and more slimy the filter beds are, the more free from bacteria is the water passing through them. In fact, in a case brought before the recent Royal Commission, sand filtration had reduced the bacteria present in a sample of water, from one-quarter of a million per cubic centimetre, to something like four thousand, which is a reduction of ninety-eight per cent. Still, however, four thousand bacteria per cubic centimetre will seem to many of us more than we care to imbibe, for it means over one million in a tumblerful, but we shall doubtless accept the inevitable when we remember that there are over nine thousand million bacteria in every pound of fresh butter; thirteen hundred millions in every pint of milk; and three thousand millions in every pound of sausages. Here, again, "what can't be cured must be endured."

Dr. Percy Frankland has recently drawn attention to a remarkable case where the water supply was chemically fairly pure, and yet most disastrous effects followed its use, whilst the same water,

though rendered chemically impure by the entrance of the sewage from a town of some 800,000 people, after efficient filtration was drunk without ill effects. This instance occurred in the town of Hamburg during the recent cholera epidemic. The water supply was direct from the Elbe, which, though chemically fairly pure, contained the bacilli of cholera. The town of Altona, a little farther along the river, used the river water as its supply after it had received the sewage of Hamburg, but cases of cholera there were very few indeed. It seems, likely therefore, that in future, chemical and bacteriological analyses of water must go hand in hand if we wish to obtain the fullest benefit from the scientist's work.

XXVIII.

EAST KENT NATURAL HISTORY SOCIETY'S EXCURSION TO HARRIETSHAM AND LENHAM,

24th May, 1893.

Report by Mr. G. Dowker, F.G.S., Conductor for the day.

The party, after leaving Harrietsham railway station, passed by the Church and ascended the hill till they came to the "Pilgrims' way," skirting the great chalk escarpment of the North Downs. This track, the director remarked, was a very ancient road which probably existed before the Roman occupation of Britain. Thence proceeding eastward to Flintbarn the party entered the chalk pit that has a geological interest because in it there existed a large pipe of the Pliocene red sand which had been figured and described by Mr. J. Prestwich.* Halting at this spot, the geological structure of the County was explained, and then an ascent was made to the top of the downs. The red sand noticed as filling the pipes in the chalk was stated to cap the hills, not only here, but south-east as far as Folkestone. Mr. Prestwich, in the paper referred to, considered that these did not belong to the eocene beds of like lithological character found in East Kent at Boughton Hill, and beneath the London Clay at the Reculvers, and from the absence of fossils their date remained unknown, until Mr. Harris, of Charing, found casts of fossils in the sandpipes there, which were identified as belonging to the Crag series. Thus the section had a great geological interest, for in England the Crag beds were only met with in the eastern parts of Norfolk and Suffolk, whilst geologists had formerly limited the Crag sea to the

* See Quarterly Journal of Geological Society, vol. xiv. 1858.

east. It must now (if this interpretation is correct) be supposed to have covered the Wealden area, or at least some part of it, and extended over parts of France and French Flanders. In this view of the case Mr. Dowker pointed out that the main upheaval and denudation of the chalk and Wealden beds dated back only from the Pleistocene age. It was remarked of these ironstone casts of shells that Mr. Clement Reid, the great authority on the Pliocene beds, had enumerated no less than thirty species collected from one of the pipes in the Lenham pit, by the members of the Geologists' Association, when they visited it the preceding year. Generally, the fossils represent a mixture of Miocene and Pliocene species, correlated with the Diestian sands. In structure these ironsands very much resemble those at Boughton, which are referred to the eocene series.

Ascending from this chalk pit to the summit of the chalk downs, here about 600 ft. above the level of the sea, they first viewed the panorama before them from the vantage ground gained, and then noted how level the fields were, and that they were covered with a red sand and loam mixed with large unworn chalk flints. Mr. Whitaker has called the beds of like nature found on the higher chalk downs "Clay with Flints." * From near the summit the escarpment is deeply furrowed by valleys formed by pluvial action; all tend in a north-eastern direction, and terminate at the former sea level.

At or near the West Street the party descended the hill into the Lenham pits, the peculiarly red sand with flints being conspicuously present over the chalk where the pit had scarped it. On entering the pit a large pipe was noticed; on one side it was composed of red sand and clay, but with few blocks of ironsand, whilst the other side was mainly occupied by large flints in clay. Upon breaking up the ironsand blocks a few casts of fossils were met with, of which one was similar to a mactra, one probably modiola costulata, and one a terebratula.

The excursion was mainly geological, but many plants of interest were noticed, notably: Linum catharticum; Malva moschata, by the roadside, on the top, near West Street; Fragaria vesca, with ripe fruit; Galium cruciatum, above Harrietsham Church; Ophrys muscifera; Aceras anthropophora, in the Pilgrims' way; and Tamus communis.

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* As to its origin see Mr. Dowker's Lecture, "Thoughts in a Gravel Pit," ante p. 72.

XXIX.

PLANT MOVEMENTS.

A Paper read at Dover, 20th December, 1893,

BY

MR. GEORGE DOWKER, F.G.S., &c.

An observer for the first time of a drop of water placed under the microscope, seeing various monads, diatoms, or desmids in motion, would naturally imagine that they belonged to the animal kingdom, for that animals alone possess the power of locomotion (although known to be a fallacy by the Botanist) is a very common and almost popular belief.

It must be confessed that the Naturalist in his endeavours to explain these movements meets with many difficulties, particularly as nearly all the old land marks are removed that separate the *animal* from the *vegetable* kingdom, and he is compelled to acknowledge that plant movements may be nearly related to animal movements.

In the animal kingdom motion is often dependent on certain stimuli applied to nervous centres and thence transferred to the muscles. I say often, for there are certain ciliary movements constantly in action in living animals, which are not regulated by nervous centres, or muscular motion; the mucous membranes for instance, or the currents of the cavities of sponges, lined with living sarcode.

Plants, like animals, have different modes of movement; some of these may be considered under the following heads :—

1. Movements in the protoplasm of the cells, or sap movements.
2. Movements of the growing points of the roots.
3. Movements of the leaves and flowers.
4. Movements of sensitive plants.
5. Movements of diatoms and desmids.
6. Ciliary movements of zoospores.

In a favorable view of a plant cell under the microscope, we may observe constant currents, or movements, in the protoplasm, (due I believe to the vital action of the cell), these are not merely the fluid motion osmosis, but they appear to depend upon the action of *heat*, *light*, and *oxygen*, upon the living protoplasm. The movements are of two kinds; in the *first* the granules in the protoplasm

are to be seen flowing from one part to another in a regular stream, generally to and from the nucleus. This may be seen in many plant hairs, as in those of the stinging nettle, and the stamens of the spider worts; in other cells the whole protoplasm moves, carrying with it nucleus and granular contents, all of which rotate in the cell, moving up one side and down the other, as may be observed in valisneria, anacharis or nitella, and hydrocharis. In the *second* case the mass of protoplasm not only changes its external form, but also its position, with movements similar to those of the amœba, or of the white corpuscules of the blood. These motions occur in a small pulsating vacuole, and are called amœboid. They also occur in some fungi and are particularly noticeable in the swarming stages of myxomycetes of plants affected by this fungus. In the diseased cells of the root, may be found a semi-translucent, frothy, and granular, slimy mass of protoplasm, which, under the microscope can be seen to undergo slow movements. The isolated spores after a time swell and burst, and the contents escape and at once begin to move about quite independently as wriggling little bodies called Myxamœbœ. These tiny specks of naked protoplasm have powers not only of movement but even of changing their form. They exactly resemble the amœba in this respect, whilst within them a small round clear space, known as the pulsating vacuole, appears, grows slowly larger and then closes up and disappears, to reappear again in a similar way.

Movements of the points of the roots. Mr. Darwin has shown that the tips of the radicles of seedlings are sensitive to various stimulants, especially to very slight pressure, and, when thus excited, they transmit an influence to the upper part, causing it to bend from the pressed side. In some seedling plants the uppermost portion alone is sensitive to light, and transmits an influence to the lower part causing it to bend. If the tip of a radicle is subjected to the vapour of water proceeding from one side, the *upper* part bends to this side, but it is the tip which is chiefly sensitive to the attraction of gravity, and causes the adjoining parts of the radicle to descend towards the centre of the earth.

Numerous experiments upon the tips of the radicles of various plants showed that in most instances they were sensitive to contact of any small object, like a piece of card, or to dry caustic, as well as to slight injury; this peculiar form of sensitiveness is confined to the tip of the radicle for the length of 1·5 millimetres. When this portion is irritated the upper adjoining part of the radicle for a length of 6 to 12 millimetres is excited to bend away from the side which has been acted upon. The curvature thus caused is generally symmetrical, it sometimes occurs six or eight hours after the tip has been irritated, but always within twenty-four hours. Occasionally the tip from being constantly acted upon bends upwards, and

it can be made to continue doing so until it forms a curve or hook. In Mr. Darwin's experiments the growing points of the seedlings were made to impinge against a piece of smoked glass, and thus the track of the progress of the roots was delineated. Beans were allowed to germinate on bare sand, and after one had protruded its radicle two inches, it was turned upside down, so that the radicle was kept in damp air and now stood upright. A filament one inch in length was affixed obliquely near its tip, and the movement of the terminal bead was traced from 8.30 a.m. to 10.30 p.m. The radicle at first changed its course twice abruptly, then made a small loop, and afterwards a zigzag curve. These several cases of the effects of contact, or other irritants, vapour, light, and the attraction of gravity, being *transmitted* from the excited part for some little way along the organ in question have an important bearing on the theory of all such movements.

Circumnutation, called by Sachs revolving nutation, is of common occurrence, particularly amongst climbers; it derives its name from the well known fact that if we closely observe a twining stem, the extremity of which points towards the north, it will be found afterwards gradually to bend more and more eastward until it faces that point, thence onwards to the south, and in succession to the west, and round again to the north. If these movements are quite regular the apex will have described a circle, or rather a circular spiral. Even stems of seedlings, before they have broken through the ground, as well as their buried radicles, circumnutate as far as the pressure of the surrounding earth permits. In this universally present action we have the basis of the most diversified movements of the plant. Thus the stems of climbing plants, the position of young leaves, the variations of their direction by night, or towards the light, are all modifications of this law. In the hop the first formed internodes are straight and remain stationary, but the next formed, even when young, may be seen to bend on one side and travel round all the points of the compass, and as the plant continues to grow the axis of each internode becomes twisted, and then after a time assumes a rigid form. A curious point connected with this twisting is that it is in direct proportion to the inequalities of, or freedom from, support; for the stem does not become twisted when it is allowed to climb glass rods, but only rough sticks, or when hanging free in the air. Mr. Darwin thinks the purpose of this bending to all points is to find support, but that when this is gained the motion is arrested. It is certain that the revolution is not directed by the sun, for out of *thirty-nine* plants on which observations were made, *twenty-five* revolved in opposition to its course, and *twelve* towards it.

Clematis glandulosa, climbs by its leading shoots, first in one direction and then in another when allowed to ascend a perpen-

dicular stick, no use being made of the leaves, but if *the footstalk of a leaf be rubbed* with a thin twig a few times on any side, it will in the course of a few hours bend on that side, the petioles will curl round, and by the hook so made the young leaves are enabled to catch twigs they come in contact with. In the case of *Solanum jasminioides*, which is a leaf climber, it was noticed that when a petiole clasped a support, it increased in thickness in three or four days, and after a time became rigid; and on comparing a thin transverse slice of the petiole, with one from the older leaves beneath, which had not clasped anything, its diameter was found to be doubled and its structure greatly changed. In the petiole in its ordinary state is a semilunar band of cellular tissue slightly different from the cortical layer, and including three groups of vascular bundles; on the other hand in the section of the petiole which had clasped a stick, the two upper ridges had become less prominent, and the groups of woody vessels increased in diameter, whilst the semilunar band had been converted into hard woody tissue with lines radiating from the centre.

It is presumed that plants become climbers to reach the light, and to expose a large surface of leaves to its action and to fresh air. This is effected by many, with wonderfully little expenditure of organized matter, their tendrils possessing the power of movement on contact with a stick hold-fast or they can lengthen so as to sweep a wide circle. We see then how high in the scale of organization a plant may rise, when we look at one of the tendril bearers. It gets ready for action almost as a polype puts out its tentacles to seize its prey. If a tendril be displaced, it is acted upon by the force of gravity, and rights itself. It bends towards the light or away from it, as may be most advantageous. When the tendril strikes some object it curls round and tightly grasps it, and in the course of a few hours it contracts its spire, dragging up the growing plant after it. By growth the tissues become wonderfully strong and durable.

Stems, petioles, flower peduncles, and tendrils, spontaneously revolve, the motion being contingent on the youth and vigorous health of the plant.

The term nyctitropic, or night turning, may be applied to both leaves and flowers when their movements are modified by alternations of day and night. The petals of flowers when they go to sleep, move either upwards or downwards as may be seen respectively in the daisy, and pyrethrum, or field chrysanthemum. The leaves not only do the same, but in the case of some compound ones, move forwards towards the apex, or backwards towards the base, from the movement of the *pluvini*, or joints, which become more turgescent on the opposite sides. Many plants grow in such

manner that the upper surfaces of their leaves avoid facing the zenith at night, others, as the oxalis or wood sorrel, bring their surface faces in contact, thus protecting the upper part from chill by radiation. It has long been known that the leaflets of the genus *Averrhoa* sleep at night and move spontaneously at daylight, also that they are sensitive to touch. *Lupinus pilosus* has similar habits.

Some of the plants before mentioned have been noted as sensitive plants, but those generally so termed deserve our further examination. Amongst the best known of these is the fly trap (*Dionea fucifera*). In this plant the upper leaves are armed with bristly points or hairs which surround their margins, and from the mid-rib the two sides of each leaf close together quickly upon being touched, which enables them to imprison a fly or other insect that may alight upon the surface. In *Mimosa pudica* a slight touch at the extremity of one leaflet causes the depression of that leaflet, this movement is communicated to its neighbour and so on in succession; after an interval the plant regains its equilibrium and the original position of the leaf is resumed. Sensitive plants like animals get exhausted when the stimulus is applied too often, and require rest to recover their powers.

As possessing most remarkable motive action, as well as being influenced by certain stimulants, and capable of transmitting this influence to other parts of the plant, *Drosera*, in interest, stands at the head of all sensitive plants. I shall not enter now on those other properties it possesses in common with many animals, but confine my remarks to its motile peculiarities.

The commonest and therefore best known of the genus (*Drosera rotundifolia*) grows on bogs, and its leaves are armed with pin-headed glands. These glandular filaments (we might call them tentacles) are from 150 to 200 in number, each surrounded by an extremely viscid secretion, which glistening in the sun has given rise to the plant's poetical name *Sundew*. The tentacles on the central part of the leaf are short and stand upright, towards the margin they become longer, and more inclined outwards; each consists of a thin straight hair-like pedicel, carrying a flattened gland upon its summit, whilst spiral vessels accompanied by simple vascular tissue branch off from the vascular bundles in the blade of the leaf, and run up all the tentacles into the glands.

Such is the structure of the leaf, and if a small organic or inorganic object be placed on it, the touched glands transmit a motor impulse to the marginal tentacles; the nearer ones are first affected, and slowly bend towards the centre, and then those further off, until at last all become closely inflected over the object. This occupies

from *one* hour to *four* or *five* : the difference in time depends upon the size of the object and its nature, that is, whether it is soluble or insoluble,—on the size or vigour of the leaf,—and whether it has lately been in action. A living insect excites it more than a dead one, as in struggling it presses against the glands of many of the tentacles. An insect such as a fly, with thin integuments through which animal matter in solution can readily pass into the surrounding dense secretion, is more efficient in causing prolonged inflection, than a thick coated one like a beetle. The inflection of the tentacles takes place indifferently in light or darkness, and the plant is not subject to any so called sleep-like movements in the night. If the glands on the disc are repeatedly touched (although no object is left on the leaf) the marginal tentacles curve inwards. So again, if various fluids such as saliva, or milk, or salts of ammonia, are placed on the central glands, the same results quickly follow. Not only the tentacles but the blade of the leaf often becomes incurved. Drops of milk, and a solution of nitrate of soda, are particularly apt to produce this result, and the secretion from the glands of the leaf is increased when particles of carbonate or phosphate of ammonia are placed on the leaf. A bit of meat or an insect brings about the same action, and the secretion becomes acid. The glands also have power of absorption. About the mechanism of these movements, and the nature of the motor impulse we know very little.

The Diatomaceæ are very minute organisms, which live commonly in stagnant water, in which the majority can move about freely. When placed under the microscope they are found to consist of symmetrical siliceous valves enclosing organic matter. These valves are closed by a line of suture along which they usually divide when producing new individuals, and these frustules are supposed to be pierced by minute holes. The motion of diatoms is of a peculiar kind, a slow regular advance in a direct line, and they do not shrink from, or avoid, any body which may be in their way. The rate of movement is slow compared with that of some of the infusoria, but as compared with the crawling movements of some animals it is exceedingly rapid. No organs capable of producing these movements are apparent. Various suggestions have been offered to explain them, such as (1) the existence of endosmosic and exosmosic currents, (2) the existence of cilia in some part, (3) a snail-like foot protruded from the frustule. It seems, however, from an elaborate memoir by Professor Schultz, that the clear hyaline matter within the frustules flows slowly over the exterior of the valves, moving with the inner protoplasm, the flow of which is more obvious from the presence of granules. Hence the band of protoplasm has the nature of a foot by which the diatom creeps along. The same kind of movement may be seen in the desmids.

Lastly, let us consider the ciliary movements so commonly met with in the zoospores, and some of the lower algæ. Cilia are by no means confined to the animal kingdom; they consist of hair-like prolongations from the surface of animal and vegetable bodies that are bathed in fluid. During life and for some time after death, the cilia are usually in constant movement, giving the parts of the field of the microscope in which they are situated a tremulous motion. They are large and easily seen in the gills of the common mussel. In land vegetation cilia may be seen in all the higher stem-forming cryptograms, in lycopodiaceæ, ferns, equisetaceæ and mosses, and in the water plants, characeæ, algæ, and others, upon which they are found upon the filaments (spermatozoids) discharged from the antheridia. The zoospores of *vaucheria* are clothed with them over the whole surface. Perhaps the most interesting of these is *volvox globator*, now classed with the confervoid algæ, but for a long time regarded by Naturalists as belonging to the animal kingdom. *Volvox* is the largest species of its family, averaging $\frac{1}{50}$th of an inch in diameter, it resembles a green sphere, like a glass bubble filled with water, but studded all over with small green spots at regular intervals, which give it its green colour. Seen in profile, these spots which are the zoospores are drop-shaped, the pointed end just penetrating the sphere, whilst two delicate hairs (cilia) are seen to project from the pointed end; By means of these the round sphere of the volvox is kept in motion in the water. The cilia all act in concert, producing at times a steady rolling motion, but occasionally the volvox stops and changes its direction. Watching these pear-shaped zoospores with a high power we notice a bright red spot (formerly called an eye) and hollow spaces termed vacuoles, which have a curious power of contracting at intervals of about forty seconds. If one of these is detached from the parent sphere it will be seen to be exactly like the form of the zoospore produced from other algæ, and it moves about in the water by the aid of these two cilia. Within the volvox you may generally notice other rotund green bodies which are liberated after a time when the parent cell bursts and sets them free to live their own lives. Towards autumn, instead of these green spheres being produced, spindle shaped ciliated bodies escape, and coming to rest change in colour and then move about, not by cilia, but by bulging out in different directions, and thus they make a slow progression, in fact become amœboid.

Having now dwelt on the movements in different plants belonging to all classes in the vegetable kingdom, I must bring this long chapter to a close. We may learn from it many curious points that connect the vegetable with the animal world. One at least is apparent, that plants, though for the most part fixed, have nevertheless in common with animals many modes and means of movement; moreover these are directed to accomplish a desired

end. When free in the water they have great powers of locomotion, and the cells that perform the acts of reproduction are especially fitted for free movement, selecting with unerring precision their home of rest.

How the instinct, if I may so call it, is communicated, and by what mechanical or chemical process the act is accomplished we know not, but they certainly have been given powers that accomplish in a wonderful way the end for which they were created.

XXX.

SOME OLD PLACES IN DOVER.

Part of a Lecture delivered before the Dover Natural History and Antiquarian Society,

BY

MISS HORSLEY.

It is, I think, always interesting to try and picture to oneself what an old town or place looked like, long, long, ago; to try and find out what were the habits of the inhabitants, what their buildings were like, in short, looking into the past history of the place instead of being content with caring for its present welfare. It is a never ending amusement, poring over old manuscripts, interviewing old people, poking into old houses, and finding out the meaning of old customs, more especially if you are an old inhabitant; bear with me then while I describe a few places in this old town, round which a certain amount of interest centres, and about which I have been able to cull some anecdotes and pieces of information.

I have chosen some of the towers and gates, about which there seemed much to say; adding a short account of the Guildhall in the Market Place.*

The first tower, which I shall speak about, is one still remembered by very old inhabitants, though every trace of it has long since disappeared: I allude to Standfast Tower, which was part of Butchery Gate. Dover was once a strongly fortified town, when walls were the chief protection against an enemy. Whether it was originally enclosed by the Roman Emperor Severus, or not, is a disputed point, but anyhow we had walls, and gates for ingress and egress.

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* The space at our command necessitates a postponement of the concluding portion of this interesting lecture, which treats of this, as well as of the public instruments for punishments, and the tower, bells, and sun-dial of St. Mary's Church. *Eds.*

An old plan of the town in Elizabeth's days shows these walls and ten gates. The actual position of all these is somewhat difficult to decide, but, thanks to an inscription let into a house or wall where once stood the gate, we are able to determine the sites of Biggin Gate, Snar Gate, and Cow or Common Gate. Then, by careful study and comparison we can infer whereabouts stood Adrian, Severus, and Butchery Gates. Part of this last one was called, as I have said, Standfast Tower, and it was known by this name till its demolition about the year 1820. A portion of the Town Wall, which adjoined this gate, is still to be seen in Townwall Street, in the area of Wellesley Hall, but in my grandmother's days it stood considerably above the level of the road, was called The Mount, and a promenade was arranged on the top of the solid masonry. When the gateway and tower were taken down, some of the foundations were found to be of Caen stone. Why there was not an inscription placed on Mr. Shipdem's round topped house, in Townwall Street, now the residence of Mr. Bazely, to the effect that, "Here stood Butchery Gate, taken down by order of the Corporation," I do not know, for all authorities seem to agree that this was the spot where it once stood. It seems that in the days of Edward IV. this tower was converted into a "lock-up," or small prison, especially designed for the retention of obstreperous freemen, and it acquired the name of the "Freemen's prison"; sometimes, too, it was called the "Hole," and these names it retained till early in this century. As a prison it became the property of the Sovereign, and in Charles II.'s time we read of his selling it to the Corporation, and it became from thenceforth *their* property (as the other gates were) and its removal, like theirs, could be effected simply by "order of the Corporation." The tower was not much used in our grandfathers' days as a prison, and portions of it were let to anyone who cared to live there; an old sailor is remembered by elderly people as living there, and he used often to tell stories about the prisoners "in the hole" in his young days. Under the Gate was a pathway leading to what we now call the Sea Front, but it was known then as the Rope Walk, and in the river (which passed under the western part in its course to the sea) carts and horses were accustomed "to water," as they can now do only at Charlton Bridge. There were steps also leading down to the river (which can still be seen) where fishermen used to wash their nets. There is an amusing account, in an old record of the town, of one of the prisoners who spent a short time in this "Freemen's Prison," no less a personage than the Town Clerk who, for his "naughty behaviour" (as the old document puts it), was ordered there. He broke loose, apparently, and had further punishment and fines inflicted in consequence. This was in the time of Queen Elizabeth. Only two months before this disgrace fell upon the Town Clerk, he and the Mayor had to inspect some cheese which had been supplied for the Queen's Navy, and

which had been put in the store house of the victualling department at Dover. They decided that it was "very naughty cheese,"—"not worth the value of two-pence," and "too evil to be expressed." The word "naughty" seems to have been a favorite one in those days, for it was applied both to the behaviour of the Town Clerk and to the cheese which he inspected.*

Of the other gates of old Dover, we do not know very much. There is an old print of an exceedingly plain and solid gateway, with a portion of cliff behind it, which professes to represent Snar Gate (though some antiquaries doubt its accuracy). This gate was sometimes called South Gate, as the one in Biggin Street was often called North Gate. It appears, from old records, that a new one was erected in 1596 by the Corporation on the site of the old Roman one, and, in consequence, we see sometimes mentioned New Gate instead of the old mysterious name of Snar. Some of the materials used in the construction of this "Newe Gate" are said to have been brought from the disused Church of St. Peter in the Market Place, which stood on the ground lately occupied by the Antwerp Hotel, and the business premises of Messrs. Carder, Worsfold and Hayward, Brown, and Igglesden, all of which are built on consecrated ground, whilst no doubt the spot where so many human remains were lately found formed part of its Churchyard. I may mention here, as an instance of a traditionary name, that an old man now in the Union calls the corner where the confectioner's shop stands, "Peter's corner"; he did not know why he so called it, but it always "used to was" as he said. But, to return to Newe Gate, this did not stand for quite one hundred years, for in 1683 it was taken down by order of William Stokes, Mayor, as we may read on the stone let into the front of Mr. Grossman's establishment. Old men sometimes call this the "town liberty stone."

As to Biggin Gate, we have no idea what it was like, for, apparently, when it was taken down no artist had thought it worth while to make a drawing of it, nor have we any record as to the date of its building. The site of it is well known, because a tablet was placed in the side of the Rose Hotel, recording that "Here stood Biggin Gate, taken down by order of the Corporation, July, 1762." This same august body has now pulled down the Rose, and with it the tablet; but no doubt the latter will be again placed in position when the new street is formed. In 1636 the Corporation, wishing to turn to use a room in the gateway, where once had lived a watchman who sounded alarms, *let it* to a company

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* See Jeremiah xxiv. 2. "Naughty figs" as an expression used in the following reign, "very evil that cannot be eaten." *Eds.*

or guild, of shoemakers, glovers, saddlers, and cobblers, to be used by them as a place for their guild meetings, and "for no other purpose whatever." Before this date this room had been used as a lock-up for "better sort of fforreyners." In 1653 the gate was extensively repaired by order of the Mayor, Mr. Edward Prescott (ancestor to our fellow townsman of that name). As to the name of Biggin, no meaning has yet been found which is quite satisfactory. There is, in York, a Gate bearing the same name, but antiquaries in that City have formed no conclusion as to the meaning of the word. It is variously spelt; in old documents it appears as Bekyn, Bygen, Bikkene, Begin, and Biggen, but even these varieties of the name throw no light on the meaning.

Of Cow Gate we know still less than of Biggin Gate. It was called sometimes the Common Gate, because it adjoined the waste land or Common where the cows of the town were allowed to graze. These cows would be troubled to find any pasturage up there now, for all the land above the site of the old gate has been built upon for many years, and some of it enclosed as a burying place for St. Mary's Parish. The inscription let into the public house wall at the top of Queen Street, tells us that the gate was taken down in 1776. Whether it was part of a street improvement scheme of those days I do not know, but apparently it was not wholly destroyed, for in 1830, when the street was widened, remains of an arch of the old gateway were seen built into the walls of a house. The public-house, which stands on the site, bears the remarkable name of "The cause is altered." What cause does it refer to, and why is it altered? *

The next Tower to which I would draw your attention is one which many old people remember, for it was left standing in Bench Street till 1836. In all the old books about Dover and its Churches, we have recorded that this tower was part of St. Nicholas Church, one of the six Parish Churches in Dover. Canon Scott-Robertson has, however, clearly shown that that of St. Martin was a very large one, with a triple apsidal end, with high altars in each apse, dedicated to St. Nicholas, St. John, and St. Martin, that each of these had a separate incumbent and a parish assigned to him; so that in fact one roof covered the three Churches. One document he quotes stated that Archbishop Warham, in 1511, found the Church and steeple of St. Martin in "a bad state of repair, which doeth great hurt to the Church of St. Nicholas," and the churchwardens of St. John's abandoned all idea of service in their portion at this time for the same reason, which certainly points to the same thing, for otherwise they would not have been affected. So we must no longer think of the old

* Is there not a very similar sign in Westminster? *Eds.*

tower in Bench Street as belonging to a Church, but simply as a tower in St. Nicholas Ward (one of the twenty wards into which the town was once divided) and belonging to a mediæval mansion. It had no pretensions to any architectural beauty, being a very plain tower, twenty-two feet square, with walls four feet thick, and its height apparently had never been much more than forty feet. There were two rooms in the tower, one above another, their floors were supported by arches from the sides and corners, and a spiral stone staircase led to the top. The one entrance into this tower, a westerly one, had evidently once been protected by a portcullis, for when the work of demolition was going on in 1836, the grooves were found quite perfect, where once this had fitted in. It seems probable, therefore, that the tower had been intended for a place of defence. The mansion, if such it had been, was divided into several dwelling houses and a stable, having been sold to various men at different times, each of whom had adapted his portion to his own needs. One, Mr. Robert Pyall, great-grandfather to Mr. Viney Brown, bought the old tower in 1729 and lived in it. Prior to this, however, we hear that this house and the adjoining one, was in 1608, the residence of the Mayor, one Robert Garrett, the landlord of the George, which is described as being an Inn "next the tower in Bench Street"; and, in 1637, when there were many refugees in Dover, they were in the habit of holding their services, in secret, there. Sometimes this tower was used to confine French prisoners in, and it thus acquired the name of "Prison Tower," and by this name it is spoken of in Lyons' History of Dover, whilst in other places we see it mentioned as Garret's Tower. It stood opposite the Shakespear, with the main thoroughfare (which till 1836 was only eighteen feet wide) between it and the Hotel. In that year it was thought advisable to widen the street, and the last remains of St. Nicholas Tower were with difficulty destroyed. With the aid of gunpowder, however, it was done, and old men are fond of telling of the narrow escapes some of them had, when large pieces of solid masonry were thrown considerable distances when the explosions took place. In digging under the buildings a well preserved vaulted chamber was found, with substantially built pillars, and arched roof with carved stone heads at the spring of the arches, apparently about the date of Edward II. These heads are now in the Museum, but are gradually crumbling away.

Some people say that it was in the tower of St. Nicholas that there was a bench where men were apt to congregate for gossip or business, and hence the street acquired the name of Bench Street, which it bears to the present day; and in an account of the refugees in Dover "the Bench" is mentioned as the place where they met together and openly discussed their religious views, much to the annoyance of merchants who were there also. Other

authorities say this bench was in old Severus Gate, which stood where Cuff Brothers' premises now are, and where Bench Street and Snargate Street join. Be this as it may, it would in either case be an appropriate name for the street.

There is one more tower, which I wish to speak of, that is not to be seen now-a-days, though there is much to remind us of its existence. It is called the Round Tower, which well describes its appearance, but is not a very dignified title for a place of defence. In one of the colored glass windows in the Town Hall we see a representation of the embarkation of Henry VIII. at Dover, on his way to meet the King of France on the Field of the Cloth of Gold. Very conspicuous in this picture, and also in the old print from which the idea is taken, are two round towers. About one of these a good deal is known, and we can read all about its builder in old records of the town. When the Rev. John Lyon wrote his History of Dover, he mentions that part of this tower was still standing in 1813; and in 1865, during some excavations in that locality, the foundations of it were exposed to view, and some local antiquaries having gone to see it, possessed themselves of a portion of the masonry as a relic of the past. We shall always be reminded of this old tower when we see the name of "Round Tower Street" and "Lane." The builder was *Sir*, or as we should say now-a-days, Reverend John Clarke, Master of the Maison Dieu. He saw the necessity for bettering the harbour, and took the lead in the works, being supported in his endeavours by King Henry VII. First, he had constructed a bank of earth and chalk firmly compacted together, forming a headland, so as to increase the area of smooth water, which the sailors had made use of as a small harbour near Ar or Archcliff. At the end of the bank Sir John Clarke built a round tower, into the sides of which were fixed iron bolts and rings, to which mariners could moor their vessels. In an old print to be seen in the British Museum this place and tower is entitled the "Dover Wyke," or place of safety. So safe and snug were the vessels in this newly formed basin that it soon received the name of Paradise, and for two hundred years after it went by the name of Paradise Pent. When this Pent became useless and was drained off and built upon the street was naturally called Paradise Street, and so it remains to this day. But how was it that this nice arrangement of the Clerical Engineer became useless? Simply from the amount of shingle, which gradually silted up and formed a barrier at the mouth of the haven, and even forced its way over the bank which formed the headland. After Clarke's death another engineer, also a Cleric and Master of the Maison Dieu, tried to prevent this accumulation, and with that view lengthened the headland, curving it at the end, and erecting another tower; but this was soon destroyed by the waves, and the shingle continued to increase in

quantity where it was not wanted, the bank seeming to help rather than to hinder it. This gradual filling up went on till 1581, when what once had been a large basin of smooth water became only a swampy, marshy, piece of land, of no use to man or boat. In 1805 the Harbour authorities took it in hand, had it properly drained off, and by 1823 the ground was built upon, forming besides Paradise and Round Tower Streets, more imposing ones bearing the names of Hawkesbury and Oxenden, the former being the title of the then Lord Warden of the Cinque Ports, and the latter the name of a very active member of the Harbour Board in 1791, and onwards. A little alley rejoicing in the name of "Spring Place" marks the spot where a spring of fresh water once entered into Paradise Pent.

Having spoken of towers no longer visible, I have a few words to say about one which every visitor to Dover sees, either on landing at the Admiralty Pier, or in his walks in that direction. I mean, of course, the Pilots' Tower, adjoining the south-eastern corner of the terminus, and through which the train from Charing Cross now passes. It is looked upon by many of this generation as a picturesque old tower which they imagine has long stood there, but old men in the town will tell you that before it was built in 1844, the Pilots' "look-out" building was in the group of houses on the eastern portion of the land now occupied by the Lord Warden, and in 1785 Blanchard, the balloonist, went there to see and enquire about the prospect of his proposed voyage across the channel; also, that on the land "Above Wall" (we call it Adrian Street) the pilots had been given a piece of ground, where they were in the habit of keeping a look-out for vessels. The name "Above Wall" appears in old Vestry books as far back as the year 1639. The houses, once the residence of gentry, were built on ground just above a wall which had been constructed to strengthen the face of the cliff, and they were also above the Town Wall, which adjoined Adrian Gate, so that there were two reasons for the somewhat peculiar name. The land above and beyond this, which is now the St. Mary's old cemetery, and still higher the fortifications and earthworks, known as the Western Heights, was in the older days a common, and it was here that the pilots had their piece of ground, and a little shelter, till the tower at the pier end of the town was arranged. From this exalted position on the cliff they had an extensive view of the channel, which they scanned with the aid of good glasses provided for the purpose. Though this plot of ground is no longer used by the pilots, old people still talk of it as "the pilots' field," and remember the flight of steps which led from it down into Snargate Street near Mr. Court's Wine Vaults. When Charles Dickens stayed in Dover, this field was his favorite haunt. He would lie on his back, basking in the sun, and think out the details of his

coming story, and in David Copperfield he describes Betsy Trotwood's cottage as being in this pilots' field, or thereabouts. Before this "look out" was arranged, the pilots used to be kept waiting about in their cutter, ready to take the homeward bound ships safely into port, but at last this was thought inhuman, and an unnecessary exposure in bad weather; and a careful watch was kept by two pilots on the cliff, and a boat was always in readiness to take them off when required, and this plan is adhered to in the present day.

The pilots in the 17th century built a gallery in the west end of St. Mary's, in front of the ponderous organ, for their especial use, when they wished to attend Divine Service, and they obtained a faculty to hold the same so long as they kept it in repair. No one of the gentler sex was allowed to sit in that gallery. The front was adorned with an elaborate emblematical device, which has been lately sold as a relic of the past, and is preserved in a collection relative to Dover. A chandelier for the better lighting of St. Mary's Church was also given, in 1742, by the pilots, to match one subscribed for by the parishioners in 1738. We should not think that these chandeliers gave a very brilliant light, for they were only calculated to hold twenty-four tallow candles each, but it was the best that could be done before gas-lights were thought of, or composite candles invented. The gallery and the old organ have long since been removed, which has exposed to view the curious old Roman Western Arch, which was entirely hidden in olden days.

XXXI.

CROCODILES AND PERSONAL REMINISCENCES,

BY

CAPTAIN McDAKIN.

The crocodile inhabits Asia, Africa, America, and Austral.a, but not Europe.

Two well defined species occur in India, the true crocodile (native Mugger) and the Gavial (native Nacoo). The alligator is only met with on the American Continent; there is but one instance of its having been found in any other part of the world, and that is in one of the Chinese rivers. The one may be distinguished from the other by the fourth tooth on the ramus of the lower jaw showing on the outside, when the crocodile closes its mouth; the corresponding tooth of the alligator is hidden from view by being received into a pit in the upper jaw.

In the London Clay of our own country, the remains of the three species have been found together, but the reptilian fishes of the Lower Chalk lived and died at a much earlier period.

Crocodiles appear to swallow pebbles to cure indigestion. Mr. Griffiths, the fossil collector, found in the Lower Chalk at Folkestone, the remains of an Ichthyosaurus, with about two handfuls of pebbles. Sir Samuel Baker mentions that a crocodile caught in the Nile was found, when opened, to have within its stomach a quantity of pebbles, and a number of bangles. The latter had probably belonged to one or more girls whom it had swallowed; perhaps it took the pebbles as a remedy for the bangles, or girls, that had disagreed with it.

On one of my natural history excursions on the borders of Nepaul (Northern India), my dobie (Anglice washerman) had heard of, but had never seen, a crocodile, and he earnestly requested that he might accompany me. This request having been acceded to, this well filled-out, sleek man, with serene countenance, presented himself one morning ready for the expedition, arrayed in his best garments of spotless white, with a broad silver belt set with jewels (the pride and distinguishing badge of his caste). He followed me through the jungle to the river's bank, which there rose perpendicularly to about twelve feet above the water, at a distance of perhaps twenty feet from it. I chose a comfortable spot, under the shadow of the wall-like bank, for although it was the cold season, it was quite hot enough to make shade agreeable to a European, but my follower preferred to bask in the sun's warmth, and sat down close to the water's edge.

I pointed out to him, on a sandbank near the middle of the river, some crocodiles, that, like himself, had sought the sunshine, and were reposing in its warmth. We watched them gradually drop off to sleep, and saw them gape as human beings not infrequently do. The crocodile can do this to a greater extent than most other creatures.

There was then enacted before our eyes, that curious fact in natural history that has been so frequently received with incredulity. Little birds of the Plover tribe hopped fearlessly into their mouths, performing the office of living tooth-picks. Perhaps there were a dozen of these reptiles in sight, of which three or four might be muggers, and the rest gavials.

Whilst our attention was thus occupied, there was a swirl of the waters close to us, that is, close to my dobie, and out of its turbid depths there rose a monstrous form with extended jaws; I could see right down its horrid throat, a wide, deep cavern of

red skin (almost like the red morocco leather with which a travelling bag is sometimes lined), edged with a ghastly array of teeth. I raised my rifle to fire, and the dobie rising at the same instant, narrowly escaped either receiving the bullet, or being devoured by the crocodile. Perhaps the unusual appearance of a white man with a rifle was too much for the beast, so he quickly retired for strategical purposes, as did we. Afterwards, my servant and myself preferred sitting on the top of the river cliff. The escape of my follower was providential, I thought little of the incident then, for I did not at the time realize that my servant had escaped a great and real peril, but I have thanked God since. The mode of attack by a crocodile is as follows:—It may be a cow, a horse, a man, or a thirsty monkey that comes down to drink; the cunning reptile shows itself and then swims away, diving to escape observation. Its victim may suppose that it has gone for good, and in false security proceeds to the water's edge to cool itself and drink, when if a ripple on the surface be not immediately taken as a timely warning, there glides swiftly from the parting waters a terrible and relentless foe, whose huge snapping jaws close like those of a steel trap, so sudden is the motion; or, the creature may swing round its powerful tail with a blow sufficient to break all the four legs of a horse, and knock it stunned or disabled into the river, where it is quickly drawn under water to be devoured.

XXXII.

COAST EROSION, AND LANDSLIPS IN THE NEIGHBOURHOOD OF DOVER.

Extract from a "Lecture on Cliffs and Escarpments,"

BY

CAPTAIN McDAKIN.

With few exceptions, the recorded landslips of the neighbourhood have taken place from the sea cliffs, but the inland cliffs, or more properly escarpments, have occasionally afforded similar phenomena.

The perpendicular cliffs of the South Foreland attain an altitude of 350 feet; the Castle yard of Dover, 375 feet; the Citadel of Dover, 420; Folkestone Hill, 545 feet; and still farther to the westward, the extreme elevation of this part of the North Downs is reached about nine miles from Dover, at Paddlesworth, which is 625 feet above the sea.

The depth of the Chalk at Dover Convict Prison was ascertained (by a deep boring, for the purpose of supplying that

establishment with water) to be 670 feet. The Upper Greensand next in geological order is of very variable thickness and in places absent altogether; the Chalk may be therefore regarded as here resting on the Gault of 100 feet in thickness; and this again on the Lower Greensand of 250 feet.

The several beds of the Chalk, Gault, and Lower Greensand dip in a north easterly direction, and consequently are exposed in geological succession on the plane of marine erosion, for a distance of nine miles, from Dover westward.

When the softer beds occur on this plane, as at East Wear Bay, where the Chalk rests upon the Gault, the exposure of the beds is very marked. The rainwater percolating through the Chalk is retained by the Gault Clay, which, becoming plastic, is no longer able to support the weight of the 500 feet of Chalk resting on so insecure a foundation. The slipping of this foundation brings about that picturesque ruin of the cliffs so strikingly seen between Dover and Folkestone, in the part locally known from its miniature lakes, hills, and valleys, as "Little Switzerland."

Where the shingle accumulates in quantity, it plays a protective part by forming a beach that may defend the base of the cliffs for centuries against the attack of the sea, as for instance, the sea front of Dover. The surface drift of the sea caused by the prevailing south-west winds, carries the shingle to the eastward; this is intercepted by the groynes along the coast, and accumulates on their western sides. When the Admiralty pier was built, the shingle that had long formed a protecting beach to Dover, gradually travelled to the eastward, and not having been replaced by fresh accretions from the westward, the public gardens then in front of the East Cliff, were swept away, and that part of the Parade with its marine mansions threatened with destruction.

The late disaster at Sandgate was, like most of the effects in nature, not the result of one, but of several causes, among which were the slippery foundation of the Atherfield Clay, and the water-logged Sandgate beds. The rainfall in Kent is generally not more than 1·75 inches for February, but last year, 1893, the rainfall in February was 4·66 inches. The translation of the shingle from the westward, according to a local report, had been intercepted by the Seabrook wall and groynes, so that the natural weight and protection of the shingle bank, on part of which Sandgate itself stands, had been weakened or removed. The chief factors then in the cause were, the unusual rainfall, the water-logged condition of the Sandgate Beds, and the removal of the Shingle.

A large ship, the Benvenue, had been wrecked the previous autumn, and this wreck had been removed by firing heavy charges

of explosives. Some of the inhabitants attributed the whole cause of the landslip to these explosions, which may have shaken some of the dwellings, and cracked the ceilings, but they had little or nothing to do with bringing about the extensive landslip which damaged two hundred houses, some of which were entirely wrecked.

In the *Folkestone Herald* for 11th March, 1893, the following account is given:—"On Saturday evening, the 4th March, the first indications of any subsidence of the cliff began to manifest themselves Near the detached hospital in the Shorncliffe Camp, immediately above the town, a fissure began to be formed. The cliff below this line of fissure must have begun to slide towards the sea in a compact mass, carrying with it in ruinous descent a large portion of the town, and the beautiful Encombe Park, from the lodge gate of which a carriage drive leads upwards in the direction of the gardener's house, which had been recently erected and fortunately escaped damage, as it was just above the principal line of disturbance. But immediately below it the stable and conservatory were literally wrecked, immense rents in the walls caused them to lean over as if about to fall; the ground under the conservatory sank down to a depth of four feet; an immense fissure and many minor ones ran in an east and west direction, marking the line of the greatest disturbance, which passing out into Chapel Street on the east caused a great destruction of property, and in a somewhat capricious manner, walls in some instances having been cut away leaving the rest of the house intact. Standing in the main street of Sandgate, and opposite the Coast Guard Station, a very pretty residence known as Spring House presented a most extraordinary appearance, reminding one of a toy house that had been accidentally sat upon, and squeezed downwards and sideways. This house has been entirely rebuilt. Towards the west end of the town, at Wellington Place, the earth movements shattered whole rows of houses, some of these rows being cleft through from end to end, here too marking the parallelism with the sea front of the chief line of disturbance. Among the secondary phenomena caused by the landslip was the very remarkable upheaval of the town pavement, the Yorkshire flags of which were forced up like pack-ice on an Arctic coast. This was strikingly the case opposite the Coast Guard Station, where one of the men remarked that whilst the motion continued the sensation "was as though a horse was kicking up the floor of the room."

In the same way portions of the shore at low water level were upheaved, and a groyne built of railway iron and three-inch planks was crumpled up in a zigzag form.

Permanent photographs of this and other objects have been

secured and placed in the Photographic Album of the East Kent Natural History Society. Illustrations also appeared in the newspapers of the day.

The sad accident that happened under the chalk escarpment below Harpinge, on 21st January, 1891,* by which three lives were lost, was not due to a landslip so much as to an avalanche, for the frozen chalk, usually so pervious to water, allowed a large accumulation to take place on the top of the Downs. When the frozen barrier gave way, it rushed down the combe and destroying the cottage swept the wreckage of it to the other side of the road, killing a man and his wife with their infant, and carrying the roof with three children sixty yards into the fields below.

Among the few recorded landslips of the neighbourhood are the following:—

It is stated in the Phil. Trans. for 1716, that a great subsidence of the Cliff had taken place at East Wear Bay, near Folkestone. Sailors, on returning to that port, were astonished to see houses that had not before been visible from the sea, exposed to view by the sliding down of the Cliff.

The older inhabitants of Folkestone also tell us, that at one time Terlingham House, situated at the back of Cæsar's Camp, and about 500 feet above the sea, was hidden or masked by the intervening heights from sight from Folkestone, but by the sinking of the hills, near Cæsar's Camp, which are now only 400 feet, it was exposed to view.

In the Ladies' Magazine for 1801, it is stated that on the 8th March an immense fall of the cliff, about a quarter of a mile from Folkestone, took place, carrying with it the footpath to Sandgate.

In 1772, there was an extensive slip from the well known Shakespeare Cliff; and another in 1810, that is said to have shaken Dover like an earthquake.

I am indebted to Mr. J. B. Hambrook for the two following notes:—A heavy fall near Holy Trinity Church, took place on 20th January, 1853, about three in the afternoon. It was probably due to the undermining and weakening of the foundation of the Cliff by the number of caves that the inhabitants had made in its base. The dust of this fall was carried as far as the Market place, and it covered objects there. The weather had previously

* See also S. E. Naturalist, part 3, page 97.

been fine and open. In November, 1872, a large fall of the East Cliff destroyed two houses. It had been preceded by *forty-eight* days very rainy weather.

Very remarkable falls of the Cliff took place early in 1877, when the eastern end of the Folkestone tunnel, under Martello Tower number one, was so far displaced that it fell in, and at the same time, but one mile and a half nearer Dover, a large portion of the Cliff fell down, filling up the deep railway cutting. Soon after this accident, the writer went over the scene of this disaster with an intelligent Coast Guardsman, who said he saw this last slip happen, and exclaimed to his companion, "Why, the Cliff is coming down!" when like a big gun going off—so loud was the report—it fell as a straight bar, filling the cutting, overwhelming two watchmen on duty at that part of the line, and the upper portion passed right over into the sea. Mr. Griffiths, the well known fossil collector, states that the shore was forced up twenty feet in a long ridge like mound, owing to the pressure exerted by the subsiding undercliff.

In the years 1882 and 1883, large slips of the cliff partially filled the cutting on the western side of the Abbot's Cliff tunnel, dislocating the railway service for some days, and on the 23rd February, 1891, a fall of the cliff took place about 300 yards east of the Cornhill Coast Guard Station.

On the 4th November, 1892, a slip of the Gault Clay took place near the Warren Inn, carrying away the road and part of the garden. About the same time one of the heaviest falls for many years took place from the Lydden Coast Guard Station, carrying away the steps leading down to the shore. The last fall recorded up to the early part of 1894 was from the Cliffs about a mile east of Dover, and near the boundary stone of the War Department, which was displaced at the same time.

EXHIBITS AT DOVER NATURAL HISTORY SOCIETY.

1893.

Nov. 8.—Mr. Richard Kerr, F.G.S., exhibited a polished flint weapon (a neolith) found at Shorncliffe. This very fine specimen of the handiwork of pre-historic man, measures nine inches in length and weighs two pounds and three quarters. It is of the long or chisel shaped pattern and entirely free from blemish.

Dec. 20.—Mrs. Elvery showed a stalactite from one of the Caves of Gibraltar and some minerals from the Giant's Causeway, among which were specimens of vesicular trap with inclusions of Zeolite, &c.

Captain McDakin noted some boulders weighing over three pounds which had been thrown, during the late November storm, a distance of twenty yards from the edge of the parade into the roadway in front of Waterloo Crescent.

1894.

Jan. 24.—Mrs. Horsley shewed a Fungus, *Sphæria hypoxylon*, which had appeared in her garden at 28, Pencester Road, about this date.

Jan. 21.—Captain McDakin exhibited a fragment of Chalk breccia, obtained from near the railway cutting at Crabble Hill, and was of opinion that it had been formed as a wind drift of chalk particles recemented by water containing carbonate of lime.

Mar. 7.—Miss Horsley placed on the table for examination two volumes of original drawings of old Dover, executed by two generations of her family; also old engravings.

Mr. Grimes showed a very rare and valuable "Battersea enamel" representing Dover and the Bay.

Mr. Webb exhibited, by courtesy of the town Surveyor Mr. W. Thomas, some of the best specimens of the coins found in Biggin Street.

NOTES.

Ancient Coins at Dover.—During excavations in 1893, in Cannon Street, Dover, fifty-five coins were found of different denominations. All were in such poor condition, that it was desirable to obtain the opinion of an expert upon them. One, a broken silver fragment, another, a foreign coin, and a small copper token, are included in the total, but these are indistinguishable; of the remainder, *fifteen*, viz.: one silver denarius valuable only as old metal, and fourteen (small corroded specimens) apparently Roman third brass, are totally illegible and quite worthless.

The decipherable coins of modern date are three in number, viz.: William III. halfpenny, George II. farthing, and halfpenny of either George I. or early coinage of George III., but this is scarcely recognisable.

Of the more ancient, a Roman *first* brass in good condition, belongs to Trajan. It has the emperor's bust and usual abbreviated inscription upon the obverse IMP. CAES. NERVAE. TRAIANO. AUG. GER. DAC. P.M.TR.P.COS.V.P.P.,* the reverse reads S.P.Q.R. OPTIMO PRINCIPI. SC. with a winged figure offering libation inscribed VIC. DAC. (Dacian Victory).

Another *first* brass is totally indecipherable, but as there appears to be a crown with points upon the head it cannot belong to the same monarch.

A *second* brass in bad condition, is illegible excepting as to the left side of the obverse, which clearly reads IMP. NERVA. CAES. AUG. and must belong to this Emperor, whose short reign has caused his coins to be somewhat uncommon.

A smaller coin appears to have the head of Valens upon the obverse, but the inscription cannot be read.

One denarius of base silver of (probably) Valerianus.

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* These letters stand for IMP (eratori), CAES (ari), NERVAE TRAIANO AUG (usto), GER (manico), DAC (ico, P (ontifici), M (aximo), TR (ibunitia), P (otestate), CO (n) S (uli), V P (atri) P (atriæ). To the best Emperor, Cæsar Nerva Trajan Augustus, of Germany and Dacia, High Pontiff, exercising tribunicial power, for the 5th time Consul, Father of his Country. The reverse reads, The Roman Senate and people to the best prince by decree of the (tribunicial) college.

Six pieces of *third* brass indistinguishable. The effigy appears to be the same in each. The only lettering remaining on the better specimens reads ETRICUS, ETHICUS and ETDRICUS respectively. Another type spells TRICUS only. Surely these belong to Tetricus.

Two *third* brass of Carausius of different types. Carausius, Admiral of the Fleet, revolted and styled himself Emperor of Britain; his coins are very numerous, particularly in this neighbourhood, he probably coined them for the payment of the soldiers and mariners, as nonpayment of arrears of wages was for centuries the most fertile cause of insurrection amongst mercenaries of Rome.

One *third* brass of Valens in fair condition, but the margin faulty. The same likeness can be seen upon several of the undecipherable pieces.

One of very rude workmanship has been returned as of Gallic origin, it is evidently an attempt at copying some Roman coin of the period. The same remark also applies to another specimen almost too bad to be recognized other than as a coin.

Early English.

As with the Roman, it is difficult to name the majority of these with certainty.

There is a penny, probably of Edward III., this has been quite spoiled by the finder rubbing it down to ascertain whether it is really silver.

A penny showing the York mint mark which may be Richard III., Edward IV., or Henry VII. Obverse, key on the right of neck. Reverse, open quatrefoil in centre of cross.

Four coins in very bad condition, probably Edward IV. pennies, also two Durham pennies of presumably the same Monarch.

A halfpenny of the same reign, recognized by the rose in the centre of the reverse.

Half groat, Edward IV.:—C on the breast; reverse m.m., rose before posui, &c., CIVITAS CANTOR (Canterbury).

Groat, Edward IV.:—Obverse, Edward, &c., quatrefoil on side of neck. Reverse, CIVITAS. LONDON; and another, with trefoil each side neck and C on breast. Reverse, CIVITAS. COVETRE (Coventry).

A farthing, obverse, a small cross on the right of King's neck. Reverse, CAN—, the remainder of the word obliterated. This most likely is a Canterbury farthing of Henry VII., and a coin, which if in good order, would be esteemed for its rarity. Examples are wanting in many of the best cabinets, and it is greatly to be regretted that the very poor condition of the specimen reduces its value to a minimum.

These coins were found irregularly scattered through the soil, but closely adjoining the site of one of the principal gates of the town. They may then have been distributed as largesse by some of the many persons of distinction who passed through Dover. No doubt coins were lost upon many of such occasions, and if no further discoveries are made when the coming street improvements are entered upon we may assume this to be the true interpretation of the find so far as the early English specimens are concerned; yet this supposition will not account for the Roman examples, and we believe no explanation has ever yet been offered of the curious fact that that ancient people seem almost to have sown the ground with money wherever they went.

S. Webb.

Ornithology.—On the evening of the 2nd of April, 1894, a pair of partridges alighted in the middle of St. George's Street, a principal thoroughfare of Canterbury, and were without difficulty captured. The birds were either frightened by their novel surroundings, or had received some previous fright, as they did not attempt to make off. A good specimen of the buzzard was recently caught in a trap by the keeper on the Fredville estate, near Dover.

H. Mead Briggs.

Curious Nesting.—How quickly some of the feathered tribes take advantage for nesting purposes of man's contrivances! Old kettles, flower-pots, and similar implements, have often been quoted as nesting places for robins and titmice; disused letterboxes, and pumps, are also frequently mentioned as occupied for a similar purpose. The Baya bird of India speedily found out that the telegraph wires were splendid things from which to suspend its nest, and render it quite safe from attacks by serpents; not only so, but in such situations it changed its style of domicile to short round nests, as less influenced by wind, as soon as it discovered that the long pendulous nests were no longer necessary, and involved more work in their construction. Now we have another case in point, and nearer home. It is only a few years ago that the Government decided upon utilising the wastes of Lydd as an artillery practice ground; but the Wheatears (Moticilla œnanthe), have already found out that empty shells afford most capital breeding places. Not in a single instance but in many have these little birds been

noticed using these shells, and if the incidents do not show a high intellect, they at least remind one of the old adage that peace and war are intimately related. G. G.

Persistence.—A nest of a Sparrowhawk was found at Alkham this spring. It was visited daily, and an egg removed until the large number of ten had been secured, and yet the nest was not deserted. Such an occurrence is, we believe, unprecedented, but more was to follow, for a trap which had been placed within the nest, but not securely fastened, was missing on the following morning. With very little hope of success, but on the principle of nothing venture nothing have, another was set, and next day the hawk was found within it *with the first trap still attached to its leg.* Such persistence in returning to the same spot must be most unusual in birds of this tribe. [Communicated.]

Ant Swarms.—It is a disputed point, whether or not the winged ants, which in July or August swarm into the air from their nests, return to their domiciles. Most authors consider that they do; M. Forel, on the other hand, maintains that only those females become queens of the nest, which have not shared in the swarming and which have become fertilized within or on the surface of the nest. According to him the females which take part in the swarming *never* return to the original home, but indeed show a dislike to it. The turf of a garden in Dover, has for some years been infested with both black and yellow ants, the hymenial flights of which usually last for about a week. They rise in the morning from ten o'clock until one, and descend later in the afternoon. In the summer of 1893, these flights were closely watched, and were seen to join other individuals in the air; where they looked not unlike a dark cloud, so numerous were they, almost as far as the eye could reach. Whether this was the commencement of a migration is not known, but certainly none were seen to return to the garden upon either day of swarming. They thus appeared to favor M. Forel's observations. S. W.

Loving Companions.—Anecdotes of dogs and cats, true and untrue, have occupied the pages of magazines for the last hundred years and more; so we may be excused if we add one more to the total. In a Surrey village this autumn we noticed a puppy and kitten which, judging from their demeanour, were upon terms of great friendship, alternately playing and teasing one another. A few days after, whilst the puppy was asleep in a basket, the kitten approached, and ensconcing herself in a nook behind the other's back, also betook herself to slumber. Upon awakening, instead of proceeding with the usual cat toilet, she began to assist in that of the puppy; licking its face, head, and ears, instead of her own, and rubbing them over with *her licked paws* in cat fashion.

In answer to enquiries we were told that it had not been previously seen to cleanse *itself* and was thought too young to do so; so that its conduct was the more remarkable.

British Association for the Advancement of Science.—Mr. A. J. Reid, on behalf of the East Kent and Dover Societies, attended the meeting of the British Association at Oxford this year. The chief subject under discussion at the Conference was that of "Local museums, their establishment, maintenance, and development." At this meeting the following resolution was passed:—"That in the opinion of this conference of delegates of the corresponding societies of the British Association for the advancement of science, all Natural History Societies should at once communicate with the Technical Instruction Committee of their County Councils, requesting them to grant money for lectures and specimens to illustrate such lectures, or for demonstrations by competent persons in the museum." Mr. Reid has, as usual, submitted to our Societies a detailed account of the meeting with his suggestions thereon.

In the Annual Report of 1893, in the list of Societies and Corresponding Societies, and their work, the following papers from our branch are noticed:—G. Dowker, F.G.S., on "Climate," and report on "Excursion to Reculver"; "Thoughts in a Gravel Pit." Captain McDakin, on "some forms of Chalk Life," and S. Webb on "Climatic Changes," and "Hibernation and Hibernating Creatures." These papers, or a digest of them, appeared in the last number of our journal. [Eds.]

VOL. I. PART V.

THE

South Eastern Naturalist.

THE TRANSACTIONS

OF THE

Associated Natural History Societies

OF THE

SOUTH EAST OF ENGLAND.

PAPERS AND NOTES

BY THE MEMBERS OF THE

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TRANSACTIONS.

XXXIII.

REPORT OF LOCAL SUB-COMMITTEES, INSTITUTED AT THE SUGGESTION OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE;

TO OBSERVE AND REPORT UPON "COAST EROSION."

Since the year 1884, when Mr. Dowker submitted to the Committee of the British Association on "Coast Erosion," a detailed account of the coast line between Walmer and Whitstable, he has made no minute survey of the coast, but in a general way has noted the changes that have taken place since then, along the before-named coast-line, which may be summarised as follows :—

At Pegwell Bay, where the greatest amount of erosion had been previously noted, the change since 1884 was most marked, the sea having not only removed the talus of the cliffs and beach which existed along the shore, but having cut back the cliff at a most alarming rate, especially where it is composed of the tertiary beds.

Eastward of Ramsgate harbour the sea has likewise removed much of the beach and sand of the shore, laying bare the chalk and undermining the cliffs, and several large falls of cliff have since taken place. Between Margate and Birchington the sea has been gaining on the shore, more especially to the West of Birchington, where the shore has been swept away and the erected groins emptied of beach.

Beyond Birchington and S. Nicholas, where the sea defences have been kept up by the Commissioners of Sewers as far as Reculver, the sea has not gained, and the defences have been effectual in retaining the beach. Between Reculver and Whitstable there has been a continued loss of land by falls of the London clay, but immediately in front of Herne Bay the destruction of coast line has not much increased, and the same may be said of Whitstable, except towards Seasalter, where the sea has considerably gained on the land, removing the greater part of an old marshy accumulation of former years.

Captain McDakin has reported on the Dover cliffs. Mr. Dowker has noted chiefly the changes that have taken place at

Deal and beyond towards Dover, and notes very little change in the beach opposite the town of Deal since his last survey, except that generally the shingle has been progressing in a N.E. direction, proceeding apparently from an old accumulation between Walmer and St. Margaret's Bay; the latter district having lost much of its old beach shingle. In some recent examinations of the coast of Dover, Mr. Dowker (who has visited this shore on numerous Geological and Natural History expeditions during the last forty years) reports that he can remember the time when a good beach existed at the base of the cliffs all the way round to Copt Point, and a large accumulation of beach and talus of cliff some feet in height existed near Lydden Spout. Now the walking along this coast is almost impracticable from the absence of beach, while at places large blocks of hard chalk reach down to the water's edge, forming an almost impassable barrier, except to experts in clambering over rocks. Mr. Dowker is led to conclude that these rock masses were formerly hid by accumulations of beach and shingle, which have of late years been entirely swept away, and probably a great portion of it redeposited just west of the Dover harbour. In this case it would seem that the great waste of shore line has here been the result of the removal of old shingle beach, and no material derived from the West substituted. Near Lydden Spout high groins have been erected, but they are destitute of beach shingle now. Mr. Dowker's first observations on this part of the coast were made in 1858, in company with the late Mr. Mackeson, of Hythe.

Captain Gordon McDakin has reported his observations on the Dover Cliffs for the last three years.

N.B.—Both Mr. Dowker's and Captain McDakin's reports on "Coast Erosion" are printed *in extenso* with the British Association transactions for 1895.

Geological Photographs.

Photographs have been taken by Mr. Dowker, showing two junctions of chalk, and Thanet beds, Pegwell; two upper chalk of Pegwell Bay, with numerous small faults, one drift bed over the chalk, Pegwell.

Geological Photographs have been taken by Captain McDakin.

Mr. Dowker's Photos and observations were not completed until after the date they should have been presented to the British Association in order to appear in the last year's record.

Local Botany.

A Paper has been submitted by Mr. J. Reid on some observations made on the *Seed-Produce of Malva Moschata.*

XXXIV.

THE DOVER COAL FIELD.

BY

CAPTAIN McDAKIN.

Captain McDakin, in a Lecture on Coal, with special reference to the Dover Coal Boring, said :—

At a meeting of the East Kent Natural History Society in December, 1887, Mr. G. Dowker, F.G.S., read a Paper on the probability of finding coal in Kent, and referred to a remarkable paper by the late Godwin Austen, read before the Geological Society in 1855, dealing with the same subject, and expressing the opinion that the Coal Fields of England, France, and Belgium were once continuous, and that the present Coal Fields are mere fragments of a great original deposit. Mr. Dowker said we may, with certainty, conclude that the primary rocks underlie the Northern part of Kent at a less depth than 2,000 feet, and therefore the Coal Measures will probably be met with. But the sections obtained by boring seem to show that the overlying beds are thinnest towards the N.E., and he concluded that the Isle of Thanet would be a favourable site for the proposed boring.

The facts brought to notice by the Dover boring fifteen years after have largely confirmed these views.

When the Dover and Calais tunnel scheme was interdicted in 1882, Mr. Chamberlain, then President of the Board of Trade, and Mr. Brady, the Channel Company's Engineer, suggested to the Chairman, Sir E. Watkin, that the presence of the Coal Measures should be tested by "boring." The spot selected was the same as that which had been chosen for the channel tunnel, near the Western entrance of the Shakespeare tunnel.

The veteran geologist, Prestwich, in his report to the Coal Commission in 1874, states:—"We know that the great original

coal trough has been broken up into separate basins. Its direction probably runs eastwards under North Wilts, Oxfordshire, Hertfordshire, the South of Essex, and the North of Kent towards Calais."

Numerous borings show us that rocks older than the carboniferous run eastward under London :

		FEET.
Chatham	Middle Oolite	943
Crossness	Old Red Sandstone......	1015
Turnford	Old Red Sandstone......	984
Ware	Silurian	795
Meux's Brewery..	Devonian..............	1065
Richmond	Devonian..............	1237
Burford	Carboniferous	1409
Calais	Carboniferous	1102
Dover	Carboniferous	1113
	Continued in Coal Measures to	2178
	Containing 21 feet of good workable coal	

The Dover Coal beds, instead of dipping at a steep angle as do the beds on the other side of the channel, are horizontal. This is a great advantage, and indicates that a central position has been struck. The coal is of good quality, and is not crushed or broken as it is in the North of France.

COMPARATIVE ANALYSIS OF COALS :

	Carbon.	Hydrogen.	Nitrogen.	Oxygen.	Heat Units.
Dover Coal	83·80	4·65	·97	3·23	14,867
Newcastle, 18 samples	82·12	5·31	5·31	5·69	14,820
Derby & York, 7 samples......	79·68	4·94	1·41	10·28	13,860
Lancashire, 28 samples.........	77·90	5·32	1·30	9·53	13,918

No mining difficulties but those of an ordinary nature need be expected, the roof and flooring being good and all surface water shut off by the impermeable grey chalk and gault clay. The worst ground was met with a short distance below the Wealden beds.

The area of coal leased or in course of settlement :

	ACRES.
Crown Leases......................	6,000
South Eastern Railway..............	200
Ecclesiastical Commissioners -........	620
	6,820

Assuming that the seams already proved maintain the same

thickness throughout the field, they represent a quantity of more than one hundred and sixty-nine million tons, or, deducting 50 per cent. for working, a yield of 900,000 tons per annum for ninety-four years.

The cost of working, including royalties, would be about six shillings and sixpence per ton, the selling price seven shillings and three pence at the pit's mouth.

I am indebted to Mr. P. S. Reid for much of the information contained in this part of my lecture, and to Mr. F. Brady for the report of the Dover boring.

History repeats itself. The long expired furnaces of the Weald may glow once more, not with the fuel of its forests, but with that of the carboniferous period, now proved to exist 2,000 feet beneath East Kent, so that Dover may rival Newcastle, and Canterbury Birmingham.

XXXV.

NOTES ON THE FRESH WATER POLYZOA OF THE DISTRICT.

BY

GEORGE DOWKER, F.G.S.

The past season has been favourable for the fresh water Polyzoa, and I have met with the following species in the Isle of Thanet and the Minster Marshes and neighbourhood of the Stour.

Cristatella mucedo was found abundantly and in large colonies in the Minster Stream in the Autumn of 1894 and again in 1895; in most cases they were attached to *Potamogeton natans*, in a slow moving stream or sewer. In the same place *Fredericella sultana* was met with but not in so great abundance. *Alcyonella fungosa* frequents the Reed Ponds, near Richborough, and large masses are met with surrounding the reeds.

Plumatella repens was found in great abundance in the small ponds on the higher ground in the Isle of Thanet, and in similar localities, *Plumatella coralloides*, and perhaps other species.

Lophopus chrystallinus we have not found here, but a few years ago it was met with in great abundance in running water

at Chartham. A friend of mine has, however, cultivated the latter for some years past in a fresh-water aquarium, so it is not particular to running water.

The localities mentioned are very prolific in Rotifers. A new species of Floscule, named *Floscularia trifid-lobata*, is described and figured in the Journal of the Quekett Microscopical Journal in November, 1895, found in this locality by Mr. Danon, of Margate, and recorded by Dr. G. M. Pittock, of that town.

XXXVI.

NOTES ON *SILENE DICHOTOMA*—A PLANT NEW TO BRITAIN.

BY

GEORGE DOWKER, F.G.S.

The *Silene* which I send these notes upon, occurred in an arable field near the top of Wingham Hill, on the north of the road from Preston to Wingham, in the Autumn of 1887. I was struck with its peculiar appearance reminding me of a large plant of *Silene nutans*. I gathered specimens for my herbarium, and saved some seed which I sowed in my garden at Stourmouth. I could not identify the plant with any described in the British flora, although it approached nearest to *Silene gallica*, of Hooker's Students' (Flora). I submitted specimens to the Rev. E. J. Marshall in 1891, and he pronounced it not *italica*, but probably some south European species. In a letter of a later date he tells me it is *Silene dichotoma*, so named by Mr. Bennett. I furnished Mr. James Reid, of Canterbury, with some of the seedlings and they grew and blossomed in his garden.

After that I kept the plant in cultivation up to the summer of 1894. It would appear that the plant is a biennial, protandrous and honey-scented at night. The stamens are very long and pendulous. The plant seems incapable of self-fertilization and rarely perfected its seed, although it bloomed freely enough. It was seen to be visited by moths at night; I was rather anxious to preserve it and therefore gathered all the seed I could find, but the last year none of this seemed perfect. It will evidently grow and flourish in this country, but I think it is doubtful if the right sort of insect visits the flowers, which may account for its seldom producing perfect seed. At Stourmouth I seem to have been more successful in getting the seed to perfect itself than here at Ramsgate.

XXXVII.

DOLOMITES.

BY

THE REV. J. SANGER DAVIES, M.A.

The Lecturer said: The Dolomite mountains in South Tyrol excelled all other mountains he had seen, (1) in the striking boldness of their form; (2) in the distinct individuality which each mountain seemed to have of its own; so much so that whenever one saw a print or photograph or view of any Dolomite, one could at once recognize the original. If anyone arrived in the Dolomite region towards mid-day he would only notice the fantastic forms of these rocks. But at sunrise and sunset they were full of colour. Whether the sunset was red, yellow, or pale, if the sun's rays while slanting could only reach the Dolomite mountains they became of the rosy pink colour shown in the water-colour drawings, the rosy colour which they also saw painted by a native artist on the two pear-shaped gourds [exhibited in the room]. From those they would see the exceeding beauty of that pink fiery glow which seemed to go through the heart of these tremendous peaks, for although rocks in one sense they were mountains in another—all of them rose to a height of nearly 11,000 feet. All this beauty was within a day's journey by train if there were a direct line to it from Kent—within 24 hours' steaming by one of our ocean steamers if the way were clear.

In considering the cause of their beauty one had to consider also what was the character of these rocks chemically. The analysis seemed to be something like this: Carbonate of lime, 54·3 out of 100; carbonate of magnesia, 45·7—there might also be a trifle of iron, but roughly speaking it had these two components: a little more than half was carbonate of lime; that is what we call limestone, or, if very soft and white, chalk, and if very hard and white, marble.

The structure of the rock was either cellular or schistose, or it might be slatey, or even earthy, and it was seldom seen in the mass unstratified.

Why was it called "Dolomite"? That was rather an unusual story. It used to be called by various German names—by Emmerling it was called "Bitter Spar," "Rhombic Spar," by Werner, and by others "Muricalcite," "Magnesian Spar," and "Magnesian carbonate of lime." Of course this last name was merely a description of its nature, but about 100 years ago, as nearly as possible, a certain Frenchman named Deodatus Guy

Silvanus Tancred de Gralet de Dolomieu, originally a Knight of St. John of Malta, entered the army, and whilst serving, he studied chemistry and geology. In the throes of the French Revolution, when they might have expected him to be attending to other matters, they found him writing from Malta in 1791 a letter in which he said he had noticed in the Southern Tyrol a certain limestone which did not effervesce with acid as readily as most limestone did, and he had also seen some similar stone worked into statues in Rome.

With regard to the geological place of these particular rocks, he might say there were known to be three different layers of them. They had the lowest bed called the "Mendolo Dolomite," but so low down that it only cropped up in the Eisack Valley. Then he believed that, with a little layer of volcanic deposit—volcanic ashes and so forth between, they had what was known as "*Schlern Dolomite*" or Middle Dolomite. This was the one with which they had to deal chiefly that evening. This was scattered about in various parts of South Tyrol. Then they had a very thin intermediate layer of raibl or rubbish, partly volcanic and partly marine, and above that occurred the third or higher Dolomite bed, generally known as the *Dachstein Dolomite*, although, like its predecessors, it had half-a-dozen names in the pages of different geological writers, chiefly German. The Dachstein Dolomite was to be found all over the eastern part of South Tyrol, the "Schlern" chiefly in the western half of that region. They differed in age and also in their fossils. While in the "Schlern" he found no fossils whatever in the course of a cursory examination, in the Dachstein he could hardly go 100 feet up a mountain side without seeing a fossil.

It was believed that this "Schlern Dolomite" was formed during a period of shallow depression and it seemed to fill the gap between the Paleozoic and Mesozoic formations in Britain. There were no beds of the same age in Great Britain, although there was a magnesian limestone. York Minster and Westminster Hall were built in part of it, and it might have the same chemical elements as the Dolomite in Tyrol, but it was not of the same age.

That brought them on to theories of the origin of these rocks, and that was a very interesting subject indeed. How were they formed? Look at the photographs and paintings, see what strange shapes these peaks assumed. They rose up in the most fantastic forms, and, for himself, the first time he saw them from an elevation and looked down he said at once, "Surely these mountains are volcanic." They had been thrown up into this peculiar form by some igneous agency from below. That theory was held by Leopold Von Buch, who said, in 1822: "The Dolomite

mountains are upheaved by volcanic force, and converted from carbonate of lime into Dolomite by the vapour of magnesia evolved from the molten volcanic rocks below and penetrating the lime stone above." There was one serious objection to this theory, and that was that these mountains appeared in about twelve or more wholly separated groups, and all these groups were as nearly as possible of the same height. It seem d very strange that there should be twelve volcanoes some 20, 30, 12, and 6 miles from each other, all reaching the same height within 100 feet or thereabouts. He (Mr. Davies) thought these facts were rather against the theory of volcanic upheaval. And, again, some fossils were found in these Dolomites. Besides, the flat top found on every one of these mountains negatives the idea of igneous protrusion.

Before stating the next hypothesis, he would like to say that these mountains assumed one of three shapes almost invariably. One set of them was upright, pinnacled, and castellated, like the Langkofel and Funffingerspitze; others were of the writing desk shape, such as the Nivolan, which had a layer of raibl impregnated with iron protecting the top of it; and the others resembled a level long spreading plateau, *i e.*, the Schlern and Sella, and were also protected on the top. The upright ones were not so protected. The next theory was that of Lepsius, who said "Schlern Dolomite was a stratified marine deposit, covering an immense area, and that the same deposit varied in thickness in the Schlern and Fassa districts, mainly owing to the outpouring, during its period of deposition, of masses of volcanic matter." There was a great difficulty in the way of that theory. If this was a sedimentary rock, there might be expected to be Schlern Dolomite all over the district. Yet they found that it occurred in isolated groups which sprung up suddenly to a great height. The answer was that all the rest had been washed away by denudation. He (Mr. Davies) thought that anyone who went into Tyrol and saw these mountains standing in the manner they did with no connection between them would say there was an immense amount of denudation to answer for. But besides that here was the difficulty. If the Langkofel mountain composed of "Schlern Dolomite" was taken to represent the thickness of the original marine deposit, then these other mountains must also have once had nearly the same thickness all over them, at least some of them which were close by. The Schlern plateau was not five miles away, and if that had been unprotected, and if they could see the protective cap on the Langkofel they would say that the cap prevented the latter from being worn away by rain and winds. But this was just the opposite of what they did find. What they saw was that the Schlern itself and other lower masses were protected, while the Langkofel was some thousands of feet higher, and yet it was not protected. He thought that showed that they had in this cap or deposit an

instance of arrested growth of this rock, so that one which did not receive the covering was allowed to grow still further (if it did grow) and reach the height which they saw, and the progress of the others was stopped by the deposit which now caps them. In other words this cap in some way or other arrested the growth of the Dolomite in the case of the lower mountains, whereas the Langkofel was not arrested, and the growth continued 2,500 or more feet higher.

There was another theory by a Canadian, Mr. T. S. Hunt, who said the Dolomites are accounted for by the action of the sea water, and that it was a metamorphic change, the sea water being at boiling point for a long time. He thought that might be admitted in the case of the Dachstein or upper Dolomite, but not for the bed they were now considering, called the "Schlern Dolomite."

The fourth theory was that of Richthofen, and it seemed to be generally accepted. He said that "The Schlern plateau was a coral reef, and that the entire formation, called 'Schlern Dolomite,' had in like manner originated through animal activity."

His idea was that it was built up by coral polyps—of which there were hundreds of different species—and that the entire formation had originated through their constructive activity. That was rather a large theory to accept, and yet, on the whole, he was inclined to accept it. The reasons Richthofen gave were these: The form of the masses, falling down sharply on each side. Their construction was very similar to an engraving of a coral island (Bolabola) which was in Professor Darwin's book on "Coral reefs and coral islands." Then Richthofen pointed to the isolation of the Dolomites from similar masses in their neighbourhood, and said there was evidence from other sources that the district they were now considering was undergoing a slow depression at the time of Dolomite formation. He pointed out that the Raibl bed, which lay in many instances over the "Schlern Dolomites," contained the fauna of a shallow sea, as much as to say that the coral polyps, which could only work at the surface or within 150 feet of the surface, received that deposit on them while the sea was still shallow, because of the numerous fossils found in that little Raibl bed. Then he pointed out that there was evidence of previous volcanic activity in this region, and the coral polyps found volcanic ashes very favourable ground for building upon, and also that there were some coral reefs in the South Pacific equal in depth to the Dolomite mountains themselves. The Lecturer understood that it had been proved that South Tyrol was during the latter portion of the Trias Period in a condition of gradual depression after a period of sub-aqueous volcanic activity, and that a great upheaval had since taken place, lifting the ocean bed up to the

level of dry land as it now appears. So much then for this theory. He might say that the latest voluminous writer on the subject—a Hungarian, he believed, named Mojsisovics—differed from Richthofen in two or three things, but accepted the coral theory entirely. He had taken the trouble to trace out all the occurrences of the "Schlern Dolomite" marked on Mojsisovics' maps and transferred them to the chart then on view. He thought they would like themselves to form some opinion on the coral island theory, and so he got Professor Darwin's book on coral reefs, atolls, and islands; and, in order that there should be no temptation to make things agree, he (the speaker) extracted the Dolomite mountains on one chart, while their Secretary extracted the coral islands from Mr. Darwin's frontispieces on another sheet. Neither of them saw each other's drawings until they were finished, but the similarity of the results were now apparent. If anyone should ask him how a circular coral reef could become a solid mountain he should reply, "That is not our difficulty. That is the difficulty of the coral people." How could a circular reef become a coral island? We had coral islands which are solid masses of coral; Barbadoes, for instance. The late Professor Froude, driving across it—it is about twenty miles across—said the top was remarkably level and reminded him of driving across the Isle of Thanet, giving an instance of a flat-topped coral island. Mr. Darwin easily solved the difficulty. He said an atoll may become a coral island, first, by "filling in." As the breakers beat upon the circle they carried over sand, shells, &c., and pieces of coral from the reef itself; thus the central lagoon would be filled in and the whole would become a solid mass, and thus an island would be formed. Then he pointed out that the dash of the waves and the beat of the sea was essential to the health of those polyps. They could not thrive in still water, and there was a continuous growth outwards. The coral would have a tendency to extend outwards, from the fact that the polyps were healthy, and build out against the fresh sea water. Some one made an experiment as to the rate of growth of these coral formations. A number of lumps of coral, each weighing 10lbs. were deposited in the sea, and it was found six months afterwards that they had grown three feet upwards. That is to say that in one year they would have grown six feet, and in 1,000 years they would have grown 6,000 feet; about the thickness of the "Schlern Dolomite" in the Langkofel. So that as far as time went they would not have taken a long geological period to form such a mass. The stratification was not nearly so marked as in the Dachstein Dolomite. But what did Darwin say about stratification of coral? If a coral island were bored through it would be found stratified all the way, and this would give those indications "falsely appearing" as if the islands had been united. That was his doctrine of corals, and the

Lecturer did not believe he thought anything about the Dolomites, but was speaking solely about the corals. So much then for that identification of Dolomite mountains with coral islands.

What followed? If this theory that the Dolomite mountains were formed by the agency of coral polyps held good, then they could draw upon descriptions of the coral islands in the sunny Southern seas for a picture of the beauties and splendours of Tyrol as it was in ancient days. They would see that while these busy builders reared their decorative towers, absorbing the pearly shell and the crystal sand, the palm trees were waving over the land their graceful fronds, all the luxuriant vegetation of the tropics was there with its bright flowers and the still brighter plumaged birds and more brilliantly painted insects radiant in their flight. And these, in turn, would give way as the shades of night fell to still more beautiful features; for all writers said that the chief beauty of the tropics was the beautiful night with the fireflies and the soft, deep, purple distances. All these things had gone, not a trace of them was to be seen in the Dolomite region now. They were gone without a fossil bone or beak. The brilliant birds were dead, and butterflies, the palms, the humming-birds—of them there was no trace left except, he thought, their beauty. That had not gone. It had been stored up for us as Nature stores up a great many other things. Nature is very conservative, no force is lost, no heat is lost, and he thought no beauty was lost either. As we now enjoyed in that room the sunlight bottled up for us ages ago in the coal measures, so travellers in the Dolomite regions now might enjoy the tropical beauties stored up in those coral polyps' castles—those Dolomite strongholds which they saw represented around them. And when the evening sun shone upon them, the curtains, as it were, were drawn from the windows of those castles and unveiled scenes of beauty which were beyond anything else he had seen or imagined to be anywhere on earth, teaching us that there might be something in the conservation of beauty as well as of energy.

XXXVIII.

NOTES AND OBSERVATIONS ON THE LANDSLIP AT SANDGATE,

4th and 5th March, 1893.

BY

JAMES REID, F.R.C.S., Eng., Canterbury.

As no adequate account has hitherto appeared in the South Eastern Naturalist of the physical causes and conditions of this geological occurrence, so interesting in its nature, and serious in

its results, from more skilled and abler members of the united Societies, I venture to offer the following record, founded on personal observations made on the fourth day after the commencement of the movement, and amplified by published notes of Experts consulted by the Authorities on the emergency. My own observations were communicated to the East Kent Natural History Society at its first meeting after the event.

The Town of Sandgate rests on a strip of land essentially belonging to the so-called "Sandgate Bed," * mainly composed of intermixed layers of sand and clay, flanked by the sea and its shingle-beach on the southern side, and for the greater part on the opposite side, by a sharp escarpment of the rocky beds of the Folkestone series, which forms a plateau above it, on which is placed the Shorncliffe Camp, some 200 to 250 feet above mean sea-level. The dip of these beds is to the N.E., and the face of the escarpment takes a course S.W.,W. to N.E.,E. At the Western end of the town the face of the cliff trends more to the West, and the land below it begins to widen out. The cliff then somewhat suddenly, so as to form a sharp bend, turns towards the N.W., a wider expanse of land below its base spreads out towards the shore, having a S.W. aspect. The point where this change takes place is nearly opposite to the Coastguard Station at the West end of the town, and the greater part of the sloping space below the cliff, and the main-road is occupied by the house and grounds of Encombe Place; the dwellings in Chapel Street, and Spring Lane covering the remainder. The face of the land slopes at a sharper gradient here than where it spreads out towards the S.W. It was at this part that some of the most serious effects of the slip were noticed, and it was in the Encombe grounds that a chief motive power had its centre, which spread out, as the radii of a fan, through the land sloping at a lesser gradient towards the S.W. The more modern extension of the town was built upon this sloping undercliff, which, wherever it was untouched by road building or cultivation, gave evidence of movement in the land in past time; even some of the more recent walls and buildings had repaired cracks in them, indicating unsteady foundations. Before closing this general description of the physical conditions of the site, and drawing attention to another factor in the catastrophe,

* One of the Series of the *Lower Greensand* Section, which are thus enumerated from above downwards.

1. Folkestone bed, 90 feet. Layers of Sand-Rock intercalate with Sand beds.
2. Sandgate bed, 80 feet. Sand layers and Clay; Clay predominating at base.
3. Hythe bed, 120 feet. Greensand Rock.
4. Atherfield Clay, 30 feet. Argillaceous bed.

the natural drainage of the district, some other circumstances that were noted previous to the occurrence may be mentioned. The depth of the shingle on the shore, in making a sea-protecting wall opposite the Parade walk, was ascertained to be 23 feet deep; this shingle rested on a bed of dark clay. Strong gales in previous years had so scoured the shore as to disturb the base upon which the sea-wall, flanking the main road at this end of the town, rested, causing fractures in several places that required to be underset. At low tide streams could be seen flowing from under the wall, and large quantities of light-coloured sand covered the clay beds extending along the shore. Further out to sea, at the lowest tides, rocks of the Hythe bed, which succeed to the Sandgate bed, are exposed to view.

It was on these rocks, and during the gales alluded to, that the ships Calypso and Benvenue, in different years, foundered, and their wrecks were broken up by explosives, and removed as a safeguard to the coasting navigation under orders of the Admiralty.* The scouring action of the gales may have been one element in the mischief by weakening the so-called "Toe" of the land that supported the weight above. After the experience with regard to the sea-wall, groynes were added to hold and increase the deposit of shingle.

The Natural Drainage of the District.

The Shorncliffe plateau under which Sandgate is placed, is flanked by two valleys taking a northern course from the shore, Horn Street Vale on the West, Encombe Vale on the East, crossing obliquely the line of dip of the beds they cut through, and carrying the water issuing from the Lyminge Vale and from the surface above the Folkestone bed, as well as the springs issuing, on the dip of the bed, from under it, onwards to the sea. The Folkestone bed, composed of thick layers of the Greensand rock, intercalated with softer sandy soil, is largely an absorbent bed, in which from the intervening rock-layers, water may be irregularly transmitted; on the other hand the Sandgate bed, from its layers of clay which appear to accumulate towards its base, has more a retaining character, by which water, moistening the impervious clay beds, converts them into argillaceous way-boards, upon which, when sloping, superincumbent matter may slide. In the neighbourhood of Canterbury, at St. Thomas' and Tyler Hills, where the London clay-bed crops out with a variable gravel deposit of about 12 feet above, and the sandy Woolwich below it, the moisture percolating through the upper deposit produces an irregular sloping

* Some of the inhabitants of Sandgate attributed the landslip to the remote influence of the vibration of these explosions disturbing the soil of the undercliff.

surface, with a tendency to glide downwards in undefinable masses, making the land quite unfit for building purposes.

From the corner in the cliff on Encombe grounds, described above, to the opening of Horn Street Vale, springs of water issue from the base of the ridge along the strike of the Folkestone bed, and find their way to the shore through the irregular sloping under-cliff of the Sandgate bed.

Influence of the Rainfall.

As part of the general consideration of the physical conditions of the soil, and in connection with the natural drainage of water through it by "springs," the antecedent rainfall should be stated as being, probably, an initial agent, giving an additional weight and impulse to the important action of water in the matter. I have met with no local information on this point, but I will state my own observations at Canterbury, 15 miles N.W. of Sandgate, which may be taken as fairly approximating a local record. During the last quarter of the year 1892, 10·79 inches were noted, being more than a third of the whole amount for the year. During January and February, 1893, a considerable amount was registered. February ultimately proved to be the wettest month of the year, 4·82 inches being indicated for that month. The total for the two months, including the two first days of March, gave 7·17 inches; of this amount 4·08 inches fell continuously twelve days preceding the occurrence, which took place about thirty-six hours afterwards. It may here be better noted that it was reported, on good authority, that the lawn in the upper part of the Encombe grounds had been quite dry during the previous winter; whereas in former winters it had been sopping wet; this suggests that either the subsoil water had made freer channels or produced new ones.

Some of the effects produced.

On the 4th of March, at 8 p.m., the first movement took place, and many buildings were seriously affected, giving rise to the greatest alarm and fear of further mischief, and a desire for immediate safety; the night being spent in giving aid and shelter to the suffering inhabitants. A second movement took place at 5 a.m. on the 5th, when the tide had receded, adding extended mischief to structures and roads. A distinct upheaval of the sea-bed, forming a ridge about four or five feet high, not far from low-water mark, was reported as having occurred during a single tide. These appear to have been the chief movements; other lesser ones were spoken of, but it is questionable whether they should not rather be assigned to results by gravitation and settlement following the more pronounced primary ones.

As the most marked features of the disturbance were observed

on the Encombe estate, a general description of them may be taken first. Here, not far from the bend in the cliff already described, but well advanced to the southward of it, lies a large mass of rock, formerly connected with the cliff above and behind it, but now forming a considerable and precipitous projection. Round this rocky prominence the carriage road ascends with a bold curve to the more level surface behind it, having on the left or western side a water-course coming from above, and passing behind the rocky ground the road crosses on the right, but eastern side of the rocks, a narrow depression passing down towards the town ; the road then reaches an extended platform laid out in lawn and gardens, with the gardener's dwelling, out-houses and glass houses adjoining. The drive continues along a planted ledge under the escarpment to the house. At the rear of this platform a marked precipitous bay, cut back in the Folkestone bed forming the cliff, indicates the position whence active and abundant springs of water issue ; these after being utilized in ornamental ponds, and supplying what is required for the dwelling and gardens, &c., descend by the water-course in the soil of the slope. It was on the crest of this level space and sloping ground, and depressions mentioned, that the most marked displacements of the soil were noticed. The rifts in the soil here showed a vertical face of 10 to 12 feet. Moreover, it was in the dwellings and surfaces of the town below, between this part and the shore, that many of the more serious consequences occurred. The titles of "Spring" House and Cottage, two of the most damaged houses, and "Spring" Lane, with damaged dwellings leading up to Chapel Street and its wreckage, were ominous names as predicting a cause that operated to *their* disadvantage and the surrounding calamity.

Other springs of water, along the strike of the Folkestone bed, similarly aided the movement, the evidences of which extended in a N.W. direction as far as the Military Hospital, a distance estimated at 1,100 yards, where they abruptly ceased, apparently from sufficient drainage at the time of construction having been effected ; and in another direction more westward, as far as the road leading upwards by Littlebourne Lodge, the limit of buildings in that direction.

Water and gas pipes were broken and the pavement upheaved along the main road at the base of the slope, as well as at other places in the line of dwellings higher up. Where the land was free from buildings along the slope, the effects of the movement were made apparent by fissures, depressions, and elevations in various forms and degrees, mostly across the apparent line of movement from above. In the roadway, a little above Littlebourne Lodge, eight or nine such fissures were observed at various distances from each other, with different degrees of displacement of the soil between

them. The lines of these ruptures were traced laterally, and the variable effects on buildings in the course of them noticed and compared with the disturbance of the ground on which they rested; many remarkable conditions of the structures were thus accounted for by the mixed terms upon which they were produced. At the roadway leading up to the path extending to the Military Hospital an 18 inch drain descending from that structure had been broken across in the upper part, and a large volume of clear water was seen flowing down in a rapid stream.

Many of the effects on buildings are well illustrated by some of the Geological Photographs presented to the East Kent Natural History Society, and preserved in their album. An excellent one, by Captain McDakin, No. 21, shows the singular effect of a double pressure on a groyne on the shore, producing a zigzag fracture; Nos. 24, 25, 27, show the effects of the displacement of land at Encombe, whilst Nos. 20, 28, 29, 30, exhibit the destruction of a glass house and injury and displacement in other structures at the same spot; Nos. 22, 23, 31 to 36, display injuries to houses in Chapel street and approximate sites; 34 is an instance of the effect of upheaval in the interior of a house, in the scullery, when the other external evidence by cracks seemed scarcely commensurate. The number of houses damaged were stated to be about two hundred. Mr. A. Bromley, the local architect and surveyor, after a special survey of one section, including seventy houses, reported that twenty-four should be condemned, forty-five might be repaired and rendered habitable.

Mr. Baldwin Latham, C.E., who was consulted by the Local authority as to the protective remedy against future mischief, recommended tapping the water in the hill by the insertion of drains at a sufficient depth in the ground where the subsidence had taken place; such drains to be carried down to the natural outlet for the springs.

In the *Kentish Gazette*, 27th February, 1894, there is a notice that Mr. Latham has notified that these works are practically completed. It was originally intended to lay the drain at a depth of nine feet, but difficulties arising from the nature of the ground, and the enormous quantity of water contained in it at the higher levels of Encombe, it was found necessary to go to a depth in places of 23 feet. The length of this drain is 4,000 feet, having attached to it five laterals of six-inch pipes, and it opens on the shore below high-water level. The work embraces the whole area of the slip from Chapel street to the ground of the War Department. The average quantity of water discharged by these drains is 36,000 gallons in twenty-four hours.

NOTES.

At the Dover Harbour Extension Works, in November, 1895, the upper molar tooth of a mammoth (Elephas primigenius) was brought up from the sea bottom; although the plates of enamel were separating from each other by chemical action, the specimen was not water worn and had no appearance of having been rolled on the beach.

SEA TEMPERATURE.—The lowest sea temperatures were taken on the 2nd, 8th, and 16th February as 36. As usual this may be accounted for by snow melting on the surface of the sea. At the end of February and beginning of March the surface temperature rose to 38, this being two degrees below the normal winter temperature of 40. The highest record was on the 3rd September of 65, being two degress above the temperature on the same date of the previous year. The highest air temperature at Dover (sea front) was on 22nd August, 82, and the lowest, 8th February, 12. A great many conger eels died of cold.—(1895).

METEOROLOGICAL OBSERVATIONS IN CANTERBURY, 1894, BY MR. BRIAN RIGDEN.

		THERMOMETER.									BAROMETER.	RAINFALL.					
	Prevailing Wind.	Average highest in 24 hours.	Average lowest in 24 hours.	Average at 9 a.m.	Highest reading during the month.	Lowest reading during the month.	Number of days of 80° and over.	Number of days of 32° and under.	Average daily range of temperature.	Greatest difference in any 24 hours.	Average reading during the month (corrected to sea level).	Total rainfall during the month (in inches).	Rainy days (·01 or more than ·01 fell in the 24 hours).	Number of days in which ·5 or more fell in the 24 hours.	Greatest number of consecutive wet days during the month.	Greatest number of consecutive dry days during the month.	Number of days on which snow fell.
January	S.	[illegible]	30·71	35·22	50° on 27th	11° on 5th		14	9·54	15° on 27th	29·964	2·70	18	1	4 from 19th to 22nd	7 from 7th to [illegible]	4
February	S.	44·25	33·11	38·46	50° on 2nd	26° on 20th		14	11·14	17° on 27th	30·105	1·39	12		5 from Jan. 29th to 2nd	5 from 18th to 22nd	
March	S., N.E.	51·03	33·87	42·61	65° on 30th	27° on 17th		12	16·54	34° on 27th	30·008	·93	10		4 from 7th to 10th	29 from March 21st to April 13th	
April	S.	59·47	41·30	52·23	72° on 8th	33° on 21st			18·17	30° on 2nd	29·918	2·28	10	2	6 from 14th to 19th		
May	S., N.	61·13	41·26	53·16	73° on 31st	32° on 27th		1	19·22	[illegible] on 31st	29·948	3·25	17	1	8 from 25th to June 1st	7 from 13th to 19th	
June	S., N.	[illegible]	48·63	60·80	78° on 29th	43° on 11th			18·73	[illegible] on 29th	30·023	2·10	11		2 from 3rd to 4th	11 from 21st to July 1st	
July	S.	71·87	52·55	64·93	85° on 1st	46° on 13th	3		19·39	28° on 1st	29·905	4·50	19	2	10 from 16th to 25th	3 from 3rd to 5th	
August	S., N.E.	67·93	51·74	60·26	75° on 25th	43° on 20th			16·19	25° on 30th	29·939	1·58	14		3 from 23rd to 25th	7 from 26th to Sept. 1st	
September	N., N.E.	60·47	46·60	55·00	69° on 19th	37° on 28th			13·93	23° on 1st	30·084	2·89	15	1	4 from 6th to 9th	5 from 10th to 14th	
October	N.E., S.	54·87	43·97	49·06	60° on 11th	34° on 21st			10·91	16° on 21st	29·034	4·12	15	1	5 from 26th to 30th	3 from 17th to 19th	
November	S.E.	49·07	38·10	43·07	60° on 1st	29° on 23rd		3	10·93	20° on 5th	30·024	4·06	14	3	9 from 9th to 17th	15 from 21st to Dec. 5th	
December .	E., S.	[illegible]	34·16	38·19	50° on 14th	24° on 3rd		9	9·19	19° on 3rd	30·014	1·52	15		3 from 13th to 15th	5 from 1st to 5th	2
							3	53				31·45	170	11			6

Thunderstorms.—There were 11 during the year, on April 26th, May 29th, June 4th, July 6th, 14th, 24th, 25th, August 6th, 10th, 24th, September 25th.

"Very high winds" were noted on 15 days:—On January 27th, February 6th, 7th, 10th, 11th, March 12th, October 24th, 26th, November 7th, 11th, 12th, 13th, 14th, December 28th, 30th.

The first ground frost in the autumn was on September 1st. An inch of rain or more fell on May 26th (1·48), June 6th (1·04), July 6th (1·00), July 10th (1·60), October 30th (1·53), November 11th (1·16).

Note.—The rain gauge is 5 inches in diameter, 9 feet 6 inches above ground, and 58 feet above sea level.

The Thermometer is 15 feet above ground, faces North, and has only the early morning sun on it.

VOL. II. PART I.

THE South Eastern Naturalist.

THE TRANSACTIONS

OF THE

Associated Natural History Societies

OF THE

SOUTH EAST OF ENGLAND.

PAPERS AND NOTES

BY THE MEMBERS OF THE

East Kent Natural History Society, and of the Dover Natural History and Antiquarian Society.

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CONTENTS.

TRANSACTIONS.

I.

REPORT OF COMMITTEE ON COAST EROSION, 1896-7.

East Kent:

From St. Margaret's Bay to Folkestone.

A very heavy fall of the cliff took place in January, 1896, about one-third of a mile west of the South Foreland Low Light. The cliff at this place is about 350 feet in height, composed of the lower portion of the Upper Chalk, and upper portion of the Middle Chalk. This great fall has intercepted the shingle, and caused it to pile up on the Western side.

Several smaller falls have taken place between this spot and St. Margaret's Bay.

St. Margaret's has lost about 12 feet, in width, of its shingle fore-shore. The whole coast from Dover to Deal has lost considerably in its natural defence of shingle. The cliffs in most places are quite perpendicular, and being exposed to the full force of the sea, and the numerous springs sapping their base, present conditions that must result in a very short time in falls on a still larger scale. The large fissures opening on the top of the cliffs, eastward of the Corn-hill Coast-guard Station, are additional indications of the same destructive action.

West of Dover great inroads have been made on the Undercliff, which together with the shingle beach long defended this part of the coast, so that considerable falls may soon be looked for.

The great fall at Lydden Spout mentioned in last year's report may be taken as an example.

Here, too, the shingle has left the coast, and the springs undermine the foundations of the cliffs, which rise to 420 feet in the Abbot's Cliff, and to 554 feet immediately to the North of Folkestone Junction. The South Eastern Railway on this part of the coast tends to preserve the cliffs by the numerous groynes and revetments by which it is defended; the latter, which were made of faggots and railway bars at the West end of Abbot's Cliff railway tunnel, were entirely destroyed last winter, and an

extensive inroad made on the undercliffs forming part of the Folkestone Warren. The Gault clay here comes on the plain of marine erosion, and forms the foundation of the cliffs. These beds of clay are the retaining strata of the rain-water that falls upon the Chalk Downs, the water issuing out in numerous springs at the sea level, so that there are three principal factors bringing about the destruction of the cliffs, namely:—the springs, the yielding Gault clay, and the absence of the protecting shingle beach.

J. Gordon McDakin.

Botanical Report.

1896.

April 6. *Rubus spectabilis.*

Growing wild in woods near Saltwood. Found by Captain McDakin; identified by G. Dowker, and the authorities at Kew.

June 6. *Salvia pratensis.*

Growing half a mile east of Dover Castle in two places. Found by Captain McDakin; identified by G. Dowker.

From Deal Northward.

The excessive wet has had the effect of bringing down the chalk in small falls between Pegwell Bay and Ramsgate, and left some parts on the cliff with fissures that look very dangerous for pedestrians. North of Ramsgate, and between it and Broadstairs again, there have been numerous small falls of the cliff. Again at Margate and towards Westgate and Birchington the same small falls have occurred. Just in the angle of the cliff East of Pegwell Bay the fore-shore has been washed away, and the sea has in places undermined the cliff. But more Eastward in Red Cliff Bay the destruction of the cliff and fore-shore has not been so rapid as in the previous year. The mouth of the Sandwich Haven has undergone several alterations; at one time something like a double mouth was formed just opposite the end of Red Cliff Bay, but lately it has resumed its last year's channel, striking inwards towards Pegwell. Since the 6-inch map was surveyed in 1872 the mouth of the river is so much altered that it is now nearer the West Cliff Houses by 2,900 feet.

By the Sandwich flats the shore-line has advanced towards Shellness Point.

G. Dowker.

II.

ON BIRDS THAT BREED ON THE SHINGLE.

ABSTRACT OF A PAPER BY W. G. GRAY,

THE CURATOR OF THE DOVER MUSEUM,

Read March 18th, 1896.

During the first week in June, 1894, I visited the breeding ground of the Terns, situated on that extensive tract of shingle lying between Dungeness and Rye, and I had the opportunity of seeing for myself the habits of several of the birds that breed in that locality. I there found the Common Tern *(Sterna fluviatilis)*; the Lesser Tern *(Sterna minuta)*; also the Ringed Plover *(Ægialitis hiaticula)*; the Redshank *(Totanus calidris)*; the Lapwing *(Vanellus vulgaris)*; the Wheatear, and Skylark, most of which I have brought for your inspection this afternoon, and which I have made up into life histories to present to our Museum. In them you will be able to see for yourselves the great resemblance of the protective colouring of the birds to their surroundings, and you will have some idea of the difficulty of finding either the eggs or young birds on a stretch of shingle about seven miles in extent. The young birds squat flat down on the ground in between the stones on the least sound of footsteps on the shingle, hence their comparative safety. I think there are two reasons why these birds build no nest: in the first place the young need no nest after they are hatched, for strange to say they disperse in opposite directions several yards apart, but I could not find out whether they get together towards night to be brooded over and kept warm by the parents; secondly, their great protection lies in the eggs or young being placed on the bare shingle, for if they built a nest it would make a conspicuous mark on the beach that would attract the notice of any person wishing to find it.

The Common Tern *(Sterna fluviatilis)* usually arrives on this coast about the middle of April, but it has been seen in some years as early as April 3rd, that being the earliest record I have been able to obtain. They commence laying about the middle of May; they make no nest but lay their eggs usually on the bare shingle, only making a slight depression on the shingle by the action of their bodies. They lay two or three eggs, usually three, but I found one nest with four, a most unusual number. They seem

to sit upon them 14 or 15 days before hatching out. As soon as the young ones appear they begin to disperse in opposite directions, lying flat on the bare shingle several yards apart. I found one young bird for two days in the nest with two eggs, but on going again on the third day I found the other two had hatched out, and that the young birds had separated in opposite directions. This clearly shows they have no use for a nest even while they are very young. It seems somewhat strange that as a cold wind is nearly always blowing over the ground they do not keep close together for warmth. The parent birds seem to choose that part of the beach on which the stones are nearest in size to their eggs, and as the shingle is very much spotted from long exposure with black, yellow and brown lichens, the stones are so nearly of the colour of the eggs that it is very difficult to find the eggs, and you would very likely step upon the eggs you are trying hard to find. The young when hatched, as you will understand from the specimens before you, are quite as difficult to find as the eggs; and, further, they lay themselves down flat on the shingle, and would allow themselves to be trodden upon rather than move. Here, again, is another great protection, as the least movement on their part would betray them.

The Common Tern is the predominant species along the shores of the Channel, and on the West side of Great Britain as far North as the Isle of Skye; while on the East it is found from Kent to the Moray Firth. In Ireland it is the more plentiful bird in the South; while it appears to rival the Arctic Tern in the North; and there it frequently nests by the margin of fresh water. The Autumnal migration lasts from August to October, but that depends entirely upon the weather. They sometimes leave us in August, but if the weather improves they may return again and remain until October. Their food consists of young Coal-fish and Sand-eels, with Shrimps and other Crustaceans. When anyone is on the ground the parents drop the food down near their young.

The Lesser Tern *(Sterna minuta)* was the next bird that came under my notice. I had great pleasure in watching this pretty little Tern, the smallest of its species as its name implies. It begins to breed about the middle of May, hatching out its young during the first week in June. Thus I was enabled to obtain specimens of them. As you are aware the sea seems to sift the shingle into different sizes, throwing it up in large ridges, the smallest usually nearest the sea. I found that this bird, like the preceding one, chooses that portion of the shingle most suitable to the size of its eggs, and not one of its eggs is to be found on the same ground as the Common Tern breeds upon. Its eggs are found on the smaller stones nearer the sea shore, hence there is the same difficulty in discovering the eggs as in the former species, for as

you will observe in the case before you they too correspond to the colours of the surroundings. The habits of the young are the same as in the last species, they hide themselves amongst the stones by lying flat down when they hear anyone approaching, which they very readily do, as you cannot walk upon the beach without making a crunching noise at every footstep you take. This, again, is another great protection to these birds, as before you step on to the shingle you perhaps cannot see a bird in the air, but as soon as you begin walking on their ground you suddenly see several pairs wheeling around you and making their peculiar pinging cry which seems their note of alarm, as it is taken up by all that are on the wing. The food of this species is much the same as that of the last. They also seem to hover over the ground and drop their food near the young, but possibly this may be only when they are disturbed, as I found several small Sand-eels near them, and upon one occasion I saw the old bird drop one and I found the young one close by. The young also separate themselves during the day. This bird breeds in suitable places as far as Cornwall. In Ireland it nests in many places, though seldom in large numbers. As a rule it leaves us in September or early in October, although I have had a stray example in the latter part of November. Saunders says that this bird seldom occurs in the Northern part of the Baltic, but is abundant on the Southern shore of that sea, and follows the course of the large rivers for so great a distance, nesting on their Islands and Sandbanks, that it extends across the Continent to the Mediterranean, Black, and Caspian seas; while it also frequents the Atlantic coast. It breeds in lower Egypt and in winter descends to the West side of Africa, to Cape Colony, and along the Asian plateau it can be traced to Central India.

The next bird that attracted my attention was that pretty little bird called the Ringed Plover, known also by the name of the Ringed Dotterel, and I was very much pleased to meet with it on its breeding ground. I found it very interesting to watch this species, but very difficult to find its so-called nest, which in fact is no nest at all, being only a slight depression made in the fine shingle, for it breeds on the same ground as the Lesser Tern. It lays four eggs, pear-shaped and of a stone buff colour, spotted with black, and nearly resembling the eggs of the Lesser Tern. I had great difficulty in finding these, as the bird uses all its arts in the first place to divert you from the spot by flying and running away from it, but should you continue on the spot where you first started the bird in a few minutes it will return and approach nearer and nearer to you, then go away again as if intent on feeding, but no doubt each time it has satisfied itself that the eggs are still safe. Now comes the question which of us will first tire out with watching, and ten to one the bird beats you, for lying in

one position, with your head perhaps over a bank, and a strong cold wind blowing through you, tires your patience ; you go away and the bird immediately goes to its eggs. If you try again, having marked the spot by the actions of the bird, and if you think of coming upon it suddenly and seeing where it rises from, it seems to have got off its nest before you have sighted it and is carrying on its old tactics, so that it is more a matter of chance than skill if you find the nest. The young of these also lie down flat as soon as disturbed, and being much smaller than Terns are even more difficult to find.

Throughout the British Islands the Ringed Plover is generally distributed along the flat portions of our coast, as well as on sandy warrens and inland lakes at some distance from the sea, while on migration it is also found on the banks of rivers. The birds which are more or less resident here and on the opposite shores of France and Holland, as well as those which arrive from the North in Autumn, are larger, more bullet headed, and duller in the colour of the mantle, than those which come from the South in the Spring and leave us after a short stay, though a few may remain to breed in Kent and Sussex.

The Kentish Plover *(Ægialitis cantiana)* is easily recognizable by its incomplete pectoral band. It arrives on the shores of England in April and departs in September. It owes its name to its first discovery on the shingle beaches of Kent, but of late years it has become very scarce, a clutch of eggs being found only occasionally. I was not fortunate enough to find any. Its habits are similar to those of the Ringed Plover, and it breeds in the same locality.

Another bird which breeds in the same locality is the Redshank *(Totanus calidris)*. I saw only about four pairs of this species. When the nest is approached they are very noisy, and practise many artifices to allure the intruder from the neighbourhood. I spent the best part of a day in trying to find their nest, but as they were evidently in a swampy portion of the ground with plenty of rushes growing, and about a foot of water, I was unable to reach them for the want of a pair of sea-boots. Later in the day I found one nest, with four eggs, built in a dry spot upon a dwarf Blackthorn, in fact the Blackthorn there is all dwarf, not reaching more than a foot or so in height from the ground. This must be attributed to the cold wind that is always blowing over it, so that it spreads out upon the beach almost like a creeping plant. This bird, though a migrant, may frequently, during open winters, be found in England throughout the year, especially in the South and West. The eggs are pear-shaped, and very much like the Lapwing's; in fact

they are frequently to be found mixed with them in the poulterers' shops. Their food consists of aquatic insects, worms, crustaceans, and small molluscs.

The next bird is the Lapwing, also called the Peewit *(Vanellus vulgaris)*, which owes its first name to the slow flapping of its rounded wings, while the latter is obviously devised from its familiar cry. It is generally distributed throughout the British Islands, and as a rule resident, though partial emigration from the North takes place in severe weather. Its favourite resorts are marshy pastures and moorlands, but its breeding grounds, even when on the flats, are usually above the risk of inundations. In England drainage and the increase of cultivation have tended to diminish its numbers; but in Scotland it is abundant, and is on the increase in many parts of the North, as well as in the Shetlands. In Ireland it is very common. This is the bird whose eggs are so eagerly sought after during the month of April for the breakfast table of those who can afford the luxury. It generally lays four, but occasionally five eggs may be found in a nest. They may be found during the latter part of March and on through April, this being the principal month for laying, but they continue throughout May and June, and no doubt this is owing to the first hatch of eggs being taken for the market. I found one clutch of eggs hard-set during the time I was in the neighbourhood, and one clutch that had been deserted and had become very much addled. It lays its eggs on the bare ground, or on what is hardly worth calling a nest. The nest is very difficult to find, as the female runs silently from it long before you are near it, and it is the male bird which indulges in such frantic swoops and twirls accompanied by noisy cries, though when the young are hatched both parents practise every artifice to allure man or dog from their brood. On the approach of winter large flocks are formed which break up in the following spring. Their food consists of worms, slugs, and insects.

The Thick-kneed Bustard, Stone Curlew, Norfolk Plover, and Great Plover *(Œdicnemus scolopax)*. This bird frequents wide downs, commons, and sheep-walks, also the shingly shores of Kent and Sussex, where it makes its appearance in March or April in small flocks which are very shy, flying round in wide circles. If disturbed from its repose it runs along very nimbly with the head poked forwards and squats amongst loose stones and the irregularities of broken ground, where the colour of the objects above favours its concealment. In Hampshire, Norfolk, Sussex, and Kent, it is tolerably common, but unfortunately the heavy and continuous firing going on between Lydd and Rye has considerably decreased its numbers in that neighbourhood. It is a shy and watchful bird, and readily takes alarm by day, this

being in reality its resting time. It is at night that it rouses up in search of food, as the dusk of evening approaches it begins to utter its loud piping cry, and trips over the ground picking up worms, insects, and young frogs, which form its chief diet. The Thick-knee makes no nest, but deposits its eggs, two in number, on the bare earth in fallow land, or on spots of ground where flint stones are scattered about, especially amongst shingle where it is interspersed with patches of grass and rushes, spotting, as it were, the earth, and favouring the concealment of the female and her progeny, whose plumage you will readily see assimilates with the chequered and mottled appearance of the surface which she has selected. The eggs are of a light yellowish brown, with darker streaks and blotches. The young, after exclusion, immediately follow their parents, and are then covered with down of a mottled grey, which gradually gives place to the proper plumage, and in about two months they are ready to fly and provide for themselves. In the autumn, after the breeding season, the flocks, which had scattered in pairs over the different breeding grounds, and the young they have reared, assemble together, forming large or small flocks, and prepare to take their departure, quitting our latitudes for a more congenial climate, and in October few, if any, are to be found in the localities previously tenanted, and where at night their loud cry had resounded.

I found that in the neighbourhood in which I stayed these birds are also called the Night Hawk by the inhabitants along the Kent and Sussex coast. No doubt this has originated from its nocturnal habit, which name has come to be familiar with the shepherds, who have the opportunity of seeing and hearing them when engaged late at night among the sheep during their breeding season. I found they were only known as the Night Hawk.

III.

ON THE MOUTH OF THE STOUR.

ABSTRACT OF A PAPER BY G. DOWKER, F.G.S.,
Read April 13th, 1896.

In this Paper the author stated that the mouth of the Stour marked in a measure the recession of the sea, and in this instance there are numerous historical data that helped us in the enquiry.

It was instructive to watch the action of a tidal river under the varying circumstances met with under excessive rainfall, and recurring high tides. The author had exceptional opportunities of noting the effects of the tides and floods in this river during his long residence at Stourmouth, and had made frequent excursions to the mouth of the river, both privately and as one of the Commissioners of Sewers. In a Paper he read before this Society, in 1880, he had recorded some of the changes that had taken place in East Kent since the Roman occupation of Britain.

According to Mr. Dowker's examination into the historical and physical evidences, there had been no (or at most very little) difference in the relative elevation of the land or sea since the Roman occupation of Kent. And, apart from the effects of elevation due to the deposits of silt in the marshes and towards the river's mouth, the land stood at the same O.D. level as at present. And there were no evidence to show that the sea level stood much higher at that period than at the present, which is a very prevailing error. It seems, indeed, that the reverse must have been the case, although the depression of the land since then is very slight.

The changes now going on may be taken as in great measure representing the changes in the past, which have been gradual, and all tending in the same direction, allowing for a greater rainfall in the past, owing to the more woody covering of the land.

The author then traced the waters from the higher lands in their descent to the sea, in detail, both under normal and abnormal conditions, which may be summarized as follows:

1. After heavy rains the swollen waters carry down a large amount of insoluble matter, which is not deposited until it meets with the still or shallow waters of the levels. And if, as generally happens, the excessive rainfall is accompanied by high tides, the water overflows the river banks, and the sediment is spread out over the adjoining land, thus tending to raise its level by a process of silting up. It is evident that where the river is not confined by artificial banks or walls, that a large expanse of the marsh must

receive the sediment, while where walls exist the deposit is limited to the space on either side of the river between the walls. Another observation shows that the river, when not embanked, is constantly shifting its channel, for here one good turn deserves another. A bend in the river (from whatever manner first formed) becomes more crooked, because the velocity of the current is thrown into the bend which it tends to still more undermine, while at the point where the velocity is diminished there will be a tendency to deposit silt. So in the case of the Stour there are repeated instances of the shifting of the river's channel, and of its finding its way through former deposits of silt. In a tidal river another force has to be taken into account. The tide will rise and fall twice in twenty-four hours, consequently the downward tendency of the fresh water is checked by the advancing tide. When this is the case, the first effect is to cause the waters to swell, while still running down, and we may likewise note that there are two currents running in opposite directions, the one creeping up the sides of the river, while the central current runs down, and just at the turn of the tide there is still water which is thick, and at this time the greatest deposit takes place. Another matter of importance is the relative strength of the tides. Off Ramsgate the flood runs N.E. about five hours and then turns West and runs down seven hours, and the same is the case at the mouth of the river. So when near the mouth the incoming tide has a greater carrying power than the ebb, the effect being that in this part of the river the silt is brought up with the tide, and deposited only where the effect is counterbalanced by the fresh waters coming down. At Rye the Commissioners of Sewers have erected flood-gates across the Rother, preventing the flood-tide coming in, the result is there is a great deposit of mud seaward of the obstruction but very little beyond.

In the case of the Stour and its tributaries, according to historical evidences, there had formerly been two outlets, one towards the S. East near Sandwich, and other N. West near Reculver; and when this was the case there must have been a rapid deposit of silt. It would seem the effect was that the Northern outlet for the Stour waters was very early stopped by the silt, and the river's course henceforth must have been at the sea at or near Sandwich.

The estuary that formerly separated the Isle of Thanet from the mainland of Kent, was called by the Venerable Bede, the Wantsum, and it flowed through the marshland now constituting the Levels of Ash, Minster and Chislet, or Reculver, the whole of which consists of Alluvium, except some detached hills at Sarre, Stourmouth, Minster, and in Ash Level.

In early Saxon times, perhaps also in Roman times, sundry

walls or embankments had been made to reclaim parts of the marsh; and in later times the course of the river Stour had been embanked some furlong or so wide on each side of the river. And we may note the effect has been to raise the soil between the banks some four feet or more, higher than the land behind the walls. And other parts that have been protected by early embankments are consequently now the lowest lands in the levels.

While the river has been lengthening its course by numerous windings, the mouth of the river has been constantly removed to a greater distance by other causes, chiefly from the tidal currents (which in this case have been in greater force from a Southern direction) forming shore drifts or shingle banks, and sand hills, pushing the mouth of the river more and more to the North. These two causes combined, have excluded the sea from its former occupancy of marshes, for the tide takes a considerable time to flow up a river, and when from this cause the flood in the river is at its highest eight or ten miles inland, the tide will have fallen some two hours or more at the mouth, where the water will be flowing out, while inland it will be flowing in.

We find from the history of Richborough that it was at this place the Romans found an excellent harbour, "the Rutupian," described as tranquil water, and the chief landing place from the Continent, before Sandwich had usurped its place; and in Danish times the hostile fleets sailed into this estuary, and out into the Thames on the North at the Reculvers. All historical evidences point to the mouth of the Wantsum being between Stonar and Sandwich. And the beach at Stonar proves to be an accumulation of prehistoric date, and had travelled from North to South from Pegwell Bay, and was formerly continuous from the one to the other, so that the exit of the waters from the Wantsum must always, within the historic period, have been by this way.

In the histories of Kent, Hasted, and every one that has written on the subject, has ignored this fact, and pictured the Wantsum estuary as having a wide mouth, extending from Deal to Pegwell, which could not have been the case.

Canon Scott Robertson suggests that Stonar was the ancient Luenderwick, and existed centuries before Sandwich. Roman and Saxon remains have been found there. The entrance to the Wantsum must at this place have been nearly one and a half furlongs wide, and the town stood at an elevation of 10 to 11 feet above ordnance datum level. That the sea in the time of the Romans did not occupy all the place now covered by sand hills, is evident from the fact that Roman remains have been found in and below the sand hills some distance North of Deal, near the rifle butts there. In a Paper read before the Royal Archæological

Institute in 1875, on the subject of Cæsar's Landing Place in Britain, the author drew attention to the probability of the mouth of the Wantsum being then near Stonar, and gave a map representing the probable state of the shore line at that time; but little notice has been taken of that map in dissertations written on the subject of the early position of this mouth of the estuary. Since that date Mr. Burrows, in his book on the Cinque Ports, goes back to the old theory of the wide mouth of the estuary. The Stonar beach, as before stated, must have been very ancient, such an accumulation of beach as there exists must have taken many years to form, and as it was there in Roman times, we must antidate it very many years before, and it could not have been the sea line even in the Saxon period, as it travelled from North to South, exactly in the opposite direction to all the more recent beaches along this coast. We must also take into account the formation of the sand hills beyond, which have accumulated since.

We now come to another part of our subject, viz., the depth and width of this estuary. Bede has recorded that in his time it was about three furlongs in breadth, and passable or fordable only in two places. The name given it, "Wantsum," would indicate that it was greatly decreasing, and we are not told where it measured three furlongs in width. Also it must have varied greatly in depth and width, according to the state of the tide. At the present time the tide rises at the mouth of the Stour 15 to 16 feet at the full and new moon. And the change from high and low water is consequently very great. At neap tides the water does not come near the shore at high water at Pegwell Bay or the high tide mark. A difference of 10 feet in the height of the tide would be sufficient to cover all the marsh with water or leave it dry. As I before stated, the distance the water will have to travel, will make a considerable difference in the height to which it would rise at a remote part of the level. As, however, the mouth of the estuary was much nearer the sea at the time of the Roman occupation of Britain, and artificial embankments had not then been erected to prevent the influx of the waters, it must have overflowed the level on Wantsum estuary at that time to its maximum extent.

Compared with the present state of the estuary, another factor must be taken account of, for in those early days the sea flowed in not only by the Eastern outlet near Richborough, but likewise at the Northern outlet near Reculvers. A careful examination of the marsh has however proved to the author that there is no great depth of the alluvial deposits over most of the marshes, and they lie but a short space above the ancient beds of tertiary strata. The subsoil in many parts is composed of the Woolwich and Thanet beds of sand (which have been confounded by many observers with alluvial sea deposits). Between St. Nicholas and

Chislet a chalk ridge underlines the alluvium at no great depth, and is met with at the bottom of the ditches. The evidences then are against the Wantsum estuary having been of any great depth. And probably the deepest part was confined to the narrow channel pictured in the map in the author's Essay on Cæsar's Landing Place.*

In respect to the Northern mouth of the estuary, it would seem that in Bede's time one of the fordable places he mentioned in the Wantsum was at Sarre, and it appears to have been one of the chief approaches to Thanet by the mainland for many years after. In a map of Thanet, attributed to Thomas Elmhan, A.D., 1414, prefixed to his history of St. Augustine's Abbey, the Island appears separated from the mainland by a continuous stream, and he depicts some Monks crossing the ferry at Sarre. And it appears that when an Act of Parliament sanctioned the erection of a bridge at Sarre ferry, A.D. 1485, the ferry boat could still be used for about one hour at spring high flood tides. It seems probable from this that this outlet of the Stour's waters had been a narrow and shallow spot for some years past. We have chiefly to do with the River Stour, but it is necessary to mention these facts as bearing on the probable state of the water in early times. A creek or bay existed North of Sarre, that allowed the tide to flow up as high as this spot at spring high tides. But the waters that ran North of Sarre, are mentioned by Bede as the Genlade. The Genlade then received the water of the valley now called the Nethergong, close by Chislet. So the two rivers of the Wantsum and Genlade are collectively to be considered as the water parting of Thanet and the mainland. And there must have been consequently a narrow part that separated these at low water and neap tides. This shallow part of the estuary is apparent from the name given to St. Nicholas (at Wade).

St. Nicholas in Thanet being a dependant of Reculver, like Sarre (or All Saints), and at stated periods they had to put in their appearance at the Mother Church at Reculver, hence arose the term *at Wade.*

What would be the effect of a tidal connection between the North mouth of the estuary by Reculver, and the Southern mouth near Sandwich ?

Going back to the earliest historical period, there must have been a flow and reflux of the waters in the estuary, consequent on the difference in the tidal constants between Deal or Ramsgate and Reculver, which, according to the present state of the tides, must have caused some of the flood tides to enter by Stonar and flow

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* Royal Archæological Institute, 1875, Canterbury Congress.

out at Reculver, there being about $1\frac{1}{2}$ hours difference between the high tides at these respective places. But probably the tide would have taken about the same time to traverse the estuary, so there could have been no great rush of waters between the two places as some have imagined. And as the author pointed out in a previous memoir, there is no reason to suppose there had been any difference in the comparative height of the land and sea level at the Roman period compared with the present. Nor had the author found any historical or physical evidences to show that Stonar had been an island, and that there had been a water passage into the Wantsum estuary North of that place; but in the annals of Sandwich we do find the rapid decay of the Haven had been traced to a sunken vessel near Richborough.

At Richborough, about the present high-water mark, a foundation of a Roman house has been found. At or near Sittingbourne, Roman burials and Roman potteries have been found *below* the level of high-water mark. Stonar, which is but 10 or 11 feet above ordnance datum, has had Roman remains found on it, and an early Roman town existed there. So the author pointed out the error of the previous writers in picturing this Wantsum as a deep and wide estuary, with a mouth extending from Deal to Pegwell. There are numerous small hills of the Woolwich and Thanet beds that stand above the alluvium of the marsh. And the alluvium on recent beds shows no evidences of marine fauna, except cockle and brackish water shells. Again the recent deposits, if we except the sand-hills between Sandwich and Deal, are of no great thickness. In some trial bores made at the time of the proposed Downs docks, specimens were exhibited of the cores from the bore tools, described as of recent deposits resting upon chalk; but Mr. Dowker, who was present at the committee room in the House of Commons, where these were shown, could testify to their being in Thanet beds, and not in recent deposits.

Turning to the history of that part of the mouth of the Stour that lies between Stonar and the sea, it was shown that some ancient barrier must have existed to keep out the sea from the word marshes, which show no evidence of marine action, and it is suggested that in the prehistoric period the land must have stood at a higher level, compared with the sea, than at the present time. Near Deal, the marshes are below high-water mark considerably; but the author of this Paper has sought in vain for any marine remains in the soil of the marshes, except such as may have been blown inland with the sand-hills.

If we require to know the effect that would be produced by letting the sea into the marshes now bordering the Stour, we have only to go to Pegwell Bay, where we may find an immense expanse

of mud at low water, covered with a shallow sea at high water. And we may note the mouth of the river running through this tract, with mud and sand banks on either side; and this we may picture to have been the state of the Wantsum estuary as Bede described it. In this case it was quite practical to recover much of the land from the sea during neap tides by the erection of sea walls, and this appears to have been the case the Monks of St. Augustine's having thus recovered large tracts of land.

The maps of the district are instructive as marking the gradual advance of the mouth of the river towards Pegwell Bay, but maps prior to the reign of Queen Elizabeth are not reliable, the earliest of these in the author's possession is dated 1579, and here we find the mouth of the river about opposite the Stonar cut. The next map, that of John Speed, dates about 1608. Then there is one by Emma Bowen, 1751; and a curious map by Christopher Packe, of Canterbury, 1743, which traces the river sources and valleys. Since these we have the Admiralty Charts and Ordnance Survey Maps. In all of these we may trace the advance of the sand-hills and Shellness point more and more Northward, till at the present time the mouth stretches across Pegwell Bay and close in to Ramsgate Harbour. It is a difficult task to trace backward, and to get at the original state of this mouth of the Stour to the date of the Roman occupation of Britain; and yet with the help of the data that these observations afford we can, with tolerable certainty, determine what it must have been. But we must not be misled by the map published in Hasted's "History of Kent," copied from Battley, which gives a very false notion, and represents a deep sea with wide mouth between Thanet and the mainland. In addition to the Stonar beach, which contracted the mouth and left but one opening towards Sandwich, there are evidences of salt marshes that stood between it and the sea shore. At Pegwell, within the memory of the author, there had been green meadows between the cliff at Cliff's End and the sea, which have since disappeared from the encroachments of the sea and the river's mouth. And it is evident that at every turn of the mouth of the river inland, there had been a destruction of the original beach, and at times this destruction of the natural defences threatened to let the sea again overflow the level between Minster and Ash. And we find that artificial embankments had been raised for the protection of the land. Such a wall is now known as the boarded groin near the end of Ebbs' Fleet lane. Ancient embankments then are monuments that speak to us of the former presence of the waters, from them we may learn that at the time of the Romans, or perhaps at the time of the Saxon and Danish invasion, the mouth of the river was near Sandwich, and that the bay between Sandwich and Pegwell had formerly been occupied chiefly by low, swampy marshes or alluvial mud banks, overflowed by the spring tides.

On these flats the sand-hills have been gradually formed, and since the Roman occupation they have extended North from near the Deal rifle butts, which then formed the Southern boundary of its mouth. Between Deal and Sandwich these sand-hills have had their greatest development, while more North the muddy marshes have predominated. So the map the author published in 1895 would fairly represent the state of matters at the early date.* In addition to the Northward growth of the sand-hills, there has been a Northward moving of the shore deposits, causing the waters of the river to be driven Northward. The same action is going on at present, and Shellness point keeps growing in the same direction.

These observations may be shortly summarized as follows :—

(1). At the commencement of the first century, an arm of the sea flowed in between the spot occupied by the town of Sandwich and Stonar, which spread out all over the present marshes called the Minster, Ash, and Chislet Levels, there having been a continuous ancient beach that extended from Pegwell to Stonar. Into this estuary the greater and lesser Stour emptied their waters at or near Stourmouth.

(2). Within this estuary the noted Rutupian harbour existed, probably chiefly connected with Richborough, Rutupiæ is a plural name supposed to refer to Richborough and Reculver. The Northern opening of the estuary presumably was early silted up, as we have found so few historical records relating to it. The Cinque Port town of Sandwich soon usurped the place of Richborough, and continued the chief Port to the Continent till the recession of the sea had deprived it of its importance.

(3). The maps prove the river to have become more tortuous, and its mouth further removed from its former position near Stonar to near Ramsgate.

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* Since this was written the author has communicated a Paper to the Kent Archæological Society, on the Landing Place of St. Augustine, accompanied with a map that may be consulted ; and since this was published, Professor McKenny Hughes has contributed to the "Essay on the Mission of St. Augustine to England," by Professor Mason, his views on the Landing Place of St. Augustine, in which Essay he has adopted nearly all the author's observations and his map also relative to this event.

IV.

RAINFALL IN INDIA.

BY

S. HORSLEY.

In a temperate climate such as that of the British Isles, the amount of rainfall in any one year is not of extreme importance, nor are the fluctuations of periodicity, and the effects of rainfall on nature, of more than passing interest to any but farmers and meteorological students. But in India the case is different, a few inches of rain more or less at a critical time may make all the difference between prosperity and famine; and this not only because of the actual effect on the vegetable kingdom, but also because in that country so large a proportion of the inhabitants depend upon the cultivation of the soil, which cultivation can only be carried on with a favorable disposition of the rainfall, both as to the amount and the time during which it falls.

It may be said with truth that Agriculture is the chief occupation of the people of India, for the census of 1872 shews that 56 per cent. of the whole population was directly engaged in agriculture, and 12 per cent. in addition were agricultural labourers, giving a total of 68 per cent.; and the census of 1882, still more carefully carried out, shewed that the percentage was 72 per cent. of the whole population.

Periodicity.

It is not enough that a given quantity of rain should fall in the year, it must fall at given times, and thereby establish those seasons which enable the farmer to cultivate his fields in the rainy season, reap the produce in the interval between the two seasons, and utilize the dry weather, after his fields have been reaped, in cultivating the rich beds of rivers, many of which present the appearance of miles of allotment gardens during the season when the heat of the sun, and the dried up condition of the fields, prevents any cultivation from being carried on, except in the light, rich, sandy beds of the rivers.

Size.

So far by way of introduction. We can now approach the subject in detail, and first let me say a word or two as to the size of the country, the rainfall in which it is proposed to consider.

Extending as it does from 8° North of the Equator right through the Zone of Cancer up to the 35° North Latitude, India presents a large field for meteorological observation, and as

two-thirds of it projects in the form of a peninsula into an ocean or expanse of water that is bounded on the West by the shores of distant Africa, on the South-East by Australia, and on the South by the Antarctic ocean, there is an individuality about the country which differentiates it from all other countries except Africa and South America.

While there is a very great diversity of language, customs, and physical characteristics of the numerous races and tribes that inhabit India, there is one point of similarity all over this large country, and that is the existence of two more or less clearly defined rainy seasons; and this renders it possible to construct, out of the tables of rainfall, a series of iso-brochetal lines, or lines of equal rainfall, which to a certain extent, and where the physical features of the country do not interfere, show a fairly regular progression from West to East.

Broadly speaking, there are two distinct rainy seasons, each with a monsoon or fixed prevailing wind of its own, and this characteristic is specially noticeable in the peninsula. From May or June till the end of August the wind blows from the west, and copious rain falls, and from October to December the direction of the wind is from the east, and the rainfall is equally great, while the period between the two monsoons is characterised by comparative dryness, heat, and absence of moisture in the wind. At the beginning of the year rainfall is almost suspended, the winds being in a transitional stage. In the south the N.E. monsoon is over, and no more rain can be looked for for some months; the barometric depression, towards which the monsoon winds were blowing, has travelled Southwards, but a new depression is forming in the mountain lands west of the Indus, and light and slightly damp Southerly winds are working up towards the centre of the depression; slight rain falls, and after each rain there comes a wave of high barometric pressure, bringing with it cool but dry N.W. winds, which are the feature of that cool season which is restricted to Northern India.

In the South the temperature rapidly rises and creates a great indraft from the sea all round the coast.

Now take the next three months. While more than half India above lat. 16° has but a rainfall of 3″ or less, the rainfall is increasing on the slopes of the Himalaya, on the N.E. coast, and to some extent on the hills and table-lands of the Madras Presidency. The rain-area is working round from the North to the East, driving the contours of 2″ further Westward. Bombay is still practically rainless, and the wind coming in from the hot plains of Beluchistan, and sweeping over Sind and Cutch, penetrates into Central India, blowing in March and April right into the province of Bengal. But here they meet the Chota

Nagpur plateau, and ascending that, they go on at the higher level, while the sea breezes from the North of the Bengal Ocean continue to blow over the plains, and thus by creating eddies, often produce those local storms which are known there as Nor-Westers. And now we reach the period of greatest rainfall, between June and October. During this season the whole of the N.W. provinces and the Panjab and down to Bombay on the West coast show a fairly regular set of contours, not increasing in value Northwards in lines running from N.W. to S.E. as in the first diagram, but in lines increasing Southwards in lines whose general direction is N.E. to S.W.

The rainfall in this season shews a more or less steady increase from 5 inches at the foot of the Afghanistan mountains, to 70 at Calcutta, and 100 to the East of Calcutta.

On the Western coast of the peninsula there is a break in the uniformity of the progression, for we find the greatest rainfall on the Western coast, where the rainfall is over 100 inches. This is due to the interception of the winds by the lofty range of mountains running down that side of India close to the coast, called the Western Ghauts. Meteorological observations establish the general law that however vapour-laden the air may be, however near it may be to the point of saturation, it does not cause a precipitation of rain so long as its general current preserves a horizontal movement, unless on its way it is exposed to considerable change of temperature. The wind observations at Calcutta shew that it is not when the monsoon is blowing steadily that rain is most probable, but when it is deflected by some local irregularity, the greater the deflection the more probable will be a fall of rain.

Any cause, therefore, which sets up an ascending movement, or any deflection at an angle to the plane of motion, such as a hill range, a coast line, or the connection of local currents round the borders of a barometric depression, causes dynamic cooling, and clouds and rain follow, the amount of rain precipitated depending chiefly upon (*a.*) the initial state of humidity in the air, (*b.*) the sine of the angle of the upward deflexional movement.

Change of temperature was alluded to as an element in the precipitation of rain from vapour-laden currents of air, and it is evident that it must be so, for cold air cannot hold water in suspension to the same degree as warm air. Starting from the vast ocean space in the torrid zone the air drinks in the abundant vapour and is carried to cooler places where saturation becomes complete because of the lower temperature. If the temperature falls still lower, the superfluous vapour is given off as mist, and ultimately, as the moisture becomes too heavy to be sustained by the air, it falls in the shape of rain.

Experiments have shown that the amount of aqueous vapours that can be held in air of a temperature of 80 is nearly five times as much as can be retained by air at the freezing point.

Air at	32°	can	sustain 2·37	grains	per	cub. ft.
,,	60	,,	,, 5·87	,,	,,	,,
,,	80	,,	,, 10·81	,,	,,	,,

Consequently if the temperature of the air falls from 80° to 60° there must be a precipitation of five grains per cubic foot of air affected by the change of temperature.

Classifying the districts of India according to amount of rainfall, they are as follows :—

INCHES.	
0 to 10.	Sind.
20 to 30.	Panjab, Khandeish, N. and S. Deccan.
30 to 40.	Upper Ganges, Rajputana, Carnatic N. Circas.
40 to 50.	Central India, Central Provinces.
50 to 60.	Western Bengal.
60 to 70.	W. Himalayas, Lower Gangetic.
70 to 80.	Pegu.
90 to 100.	Assam.
100 to 110.	Bay Islands.
110 to 120.	Malabar.
140 to 150.	Concan E. Himalayas.
170 to 180.	Tenasserim.
180 to 200.	Aracan.

From this it will be seen that the rainfall in India is not so great as it might be imagined, and that the N.West portion of Upper India and the whole of the peninsula have but a small average fall, if we except the narrow strip of country along the Western coast. On the other hand, Eastern Bengal, Assam, and all down the Burmese coast, possess a rainfall which is really large as compared with a country in the temperate zone ; England for instance, which has a rainfall of 36 inches, fairly uniformly distributed if we except Cumberland which has 189 inches.

PART II.

The effects of rainfall in a tropical country are perhaps more evident in the vegetable kingdom, and in the scenery, than in other directions, and it is evident that as most of the rain falls in seven months of the year the rate of growth is abnormal, and this growth is favored by the tropical heat which, while it assists growth during the rainy season, prevents the complete exhaustion of the plant during the dry season by checking its growth, much as the extreme of the winter in England acts on the vegetation of that country.

In India, unlike other countries subject to like conditions of rain and seasons, there is no distinctive botanical feature peculiar to itself. It differs in this respect from Australia or Africa: partly owing to its geographical position and partly to the varied climate it possesses, its vegetation is of a very composite character and may be said to be the blending of the flora of the adjoining continents.

In the N.W. the distinctive type is that derived from Persia and the S.E. shores of the Mediterranean; in the North, Siberian, in the East the Chinese, and in the S.E. the Malayan flora has given character to the local flora.

Whatever the origin of the local flora, the meteorological characteristics of different parts of India naturally affect the flora and thus for botanical purposes the country may be divided into four broad territories—the Himalayan, the North Western, the Assamese, and the Western.

In the Himalayan there is a strong admixture of European species, such as Aquilegia, Cratœgus, and the Pines of the hills, which are closely allied to those of Southern Europe, and the Taxus Baccata, or common yew, and the Quercus Ilex, or holm oak, are frequently found in the Himalayan forests.

In the N.W. where the soil is dependent to a great extent upon irrigation and inundation, tho flora partakes of a Persian or Syrian character, and the Acacia Arabica is one of the commonest trees, while the Populus Euphratica (the willow alluded to in the Bible) is to be met with frequently.

The Assamese or Malayan and the Western territories have much that is common owing to both districts being more or less perennially humid, but the Western flora partakes chiefly of the Malay character without the admixture of the Chinese element which tinges that of the Assamese district.

The Southern and drier and hotter parts of the peninsula produce in their wild state such palms as prefer strong heat and little rain, chief among which is the Palmyrah or Borassus flabelliformis. The stem is surrounded by leaves the stalks of which in the natural state do not drop off for a great number of years, but as the palm is used to obtain toddy from, the cultivators cut off the leaves until the trees present the appearance of a smooth stemmed palm.

The immense tracts of country in the extreme south of India where the rainfall is sometimes not more than 20 inches, and the heat great, is one of the great features of that part of the country, in parts of which nothing but the Palmyrah and the Acacia Planifrons are to be seen in the way of trees while the hedges are to a great extent formed by the Aloe. If any tree

may be said to be common to and characteristic of all parts of India it is the Banyan, or Ficus Bengalensis, which is seen both in moist and deciduous forests, and in the most arid parts.

In regard to the physical changes in the conformation of the land due to the effects of Rainfall, it is necessary to understand the river system of the country. Beginning with the N.E. we have the Indus with a drainage area of 311,661 square miles, its actual source being in Thibet at an elevation of 16000 ft. above the sea.

The geological formation through which the Indus proper flows is chiefly Metamorphic, while its tributaries the Jhelam, Ravi, Chenab, and Satlaj run through alluvium and lower tertiary.

Below the Indus we find the Indian desert of Rajputana with little or no rain and no river of size or importance, and immediately below, the basin of the Narbada and Tapti, stretching more than half way across India, driven in like a wedge between the basins of the Ganges on the north and the Godavery on the south. The united area of the three rivers of the Narbada basin is 85,800 miles. It will be observed that below this basin there are no more rivers flowing westward, and this is due to the fact that the Western Ghauts run down the western edge of the peninsula from a little above Bombay to Cape Comorin. Returning therefore to the north part of India we find the great basin of the Ganges, a river 1514 miles in length, with a drainage area of 391,000 square miles. The geological features of this basin are chiefly Cretaceous trap Silurian and upper tertiary.

On the extreme east of India lies the basin of the Brahmaputra 361,200 square miles in area. This river in its course of 1800 miles is so heavily freighted with silt, that the least impediment in its course causes a deposition, and a steamer anchored overnight in sufficient water, sometimes finds itself on an island of silt. Some of these silt islands are of great size, and one has been ascertained to be 441 square miles in area.

To the silt brought down by the Brahmaputra and Ganges is due much of the formation deltaic and otherwise of the land at the head of the Bay of Bengal.

Below the basin of the Ganges with its watershed in the high land of Central India the Mahanadi and smaller rivers form the next basin, below which and stretching almost across the peninsula is the basin of the Godavery, 898 miles in length, with a drainage area of 112,200 square miles. The deltaic formation of the mouth of this river is one of the features of the eastern coast, and the river is so highly charged with silt in the rainy season that the sea 8 or 10 miles out is of the colour of a muddy river, and not infrequently coasting steamers come across huge trees which have been carried down the river during floods.

The Khishna is the next river 800 miles in length with a drainage area of 94,500 miles.

The excessive rainfall in the basins of the Brahmaputra, Ganges, and Godavery, and the constant erosion of the banks and beds of those rivers, leads to the formation of that river mouth formation called Deltaic which is observable in other parts of the world where there are large rivers, as for instance, the Nile and Mississippi.

At the mouth of a Deltaic river and for some distance inland, the river bed is raised by gradual deposits of silt, and if the river is very highly charged with silt the formation of land from the original coast line sea-wards, continually goes on, thus a very important addition to, or alteration of, the features of the country is brought about by rainfall.

In Bengal a length of about 200 miles of coast consists of estuaries of the Ganges intersected by low islands entirely formed out of river silt.

The Ganges may be taken to be a typical river possessing the three stages or conditions: first, the Hill stage where it rushes down as a torrent carrying with it large stones and carving out for itself channels in solid rock; second, the low country stage where seeking the lowest levels it winds along towards its ultimate destination receiving the mud from the drainage of the land it passes through and carrying with it such parts of the detritus which its velocity enables it to carry, dropping the heavier particles, as the fall of the bed flattens, until it reduces itself to a fall of five inches per mile, as between Benares and the delta through which it still further flattens the fall to one inch per mile, which is too flat to allow the silt to be held in suspension any longer. Here then it enters upon the third stage, and its speed being checked, the river breaks up into innumerable branches, the water spills over the edges and silt is deposited thereon, marshes are formed between the branches and in course of time as more silt is deposited, these marshes are filled up. At the end of the Deltas a network of tidal creeks flows through the dark and dismal swamps overgrown with Mangrove, Pandanus, and other plants that thrive in brackish water. Here also the ocean currents find themselves checked by the out-flowing streams and they in their turn deposit their sand and thus help in the outward growth of the land.

It must not be supposed that these deltaic tracts are merely on the immediate coast line; borings and geological observations have proved that in the case of the Brahmaputra and Ganges the whole of the lower part of Bengal has thus been built up, out of the sea, by means of the river-borne silt. The head of the Delta

in both cases is about 220 miles inland from the present coast line, and it is estimated that the area of delta land at this part is 50,000 square miles with a depth of 400 feet of sand, alluvial clay, and pebbles.

In the year 1840 a boring was taken at Fort William, Calcutta, which shewed the strata to be sand, alluvial clay, sand with water-worn pebbles down to 480 feet. At a depth of 392 feet a few pieces of river washed coal were brought up.

On the Western coast of the peninsula deltaic rivers are not met with, the rivers being so insignificant in length and volume as compared with those on the eastern coast; the feature of that coast is the formation of lagoons divided from the sea by a narrow strip of sand; the sea is stronger than the rivers and bars the mouths causing the rivers to back up over the flat ground and form large lakes which take the ordinary discharge of the rivers and only in heavy rainy season does the level rise to a height sufficient to burst the bars. Some of these are 18 miles in length and some are 10 miles broad, the depth varying from 2 or 3 feet to 14 or 15. Connected as they are by canals they form a splendid line of inland water communication.

The silt brought down in the fresher and floods caused by the heavy rains, must necessarily be accompanied by a gradual denundation of the Hills, from whence the rivers and streams proceed, and there are many remarkable looking rocks or rocky hills which bear evidence of having once been covered with soil and vegetation which has been gradually washed away by the rains; the Trichinopoly rock is an example of a perfectly denuded hill.

The irresistible power of running water especially on rocks that are in the least degree soluble is nowhere more clearly demonstrated than at Jabalpur, where the river has cut through the marble rocks to a great depth, an instance of the erosive action of running water on calcareous rock.

In conclusion, a few words may be said on evaporation, which in the hotter parts of India is at the rate of $\frac{1}{4}$ of an inch per day, and necessarily is followed by a change in the hygrometric state of the atmosphere, and the damp air rising from large areas of irrigated fields is sufficient very often to so saturate the air above that rain falls in districts where rain is scarce indeed. Notably is this the case in Sind where the records show that since the extension and resuscitation of irrigation in that rainless district, the 5 inch and even the 10 inch rain contours are rapidly gaining ground. And similarly in Egypt since the construction of the Suez Canal the effect of the evaporation from that large area of water known as the Bitter Lakes has been to give a rainfall to Suez and Ismailia which was unknown to those places before 1870.

No more published.

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THE TRANSACTIONS

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OF THE

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TRANSACTIONS.

V.

NOTES ON PHENOMENA OBSERVED IN VOYAGES TO THE EAST.

A Paper by CAPTAIN E. G. STEAD,
January 11th, 1898.

The paper I am reading to-night is simply the notes I have made on my own observations of Natural phenomena during a sea life of 45 years. There is no connecting thread running through it. I simply take the phenomena in order of my notes.

Fog.

To people on land fog is of little importance outside large Cities or Manufacturing towns, but to people at sea it is a cause of great anxiety. Fog does not appear to maintain the same density throughout, for at 20 feet from the water's edge it may be so thick that objects are not visible 50 feet away, while at the same time the sea level objects may be visible a third of a mile away. In the Mediterranean Sea fogs are prevalent in the month of June, and are particulary dense. I have been steaming along in perfectly clear weather with a sea like glass, the horizon apparently visible all round, when the sound of a steamer's fog whistle has been heard, and all at once the ship has been enveloped in a dense fog which extended for several miles. One runs out of them again just as suddenly, sometimes a man stationed aloft can see over them, at other times not. One peculiar feature I noticed was that after passing out of them, the horizon again appeared to be the true one, which of course could not be the case, but the fog may have risen suddenly as we see a cloud rise in a mountainous district. I expect often when Canterbury is enveloped in a dense fog any one on the top of the Cathedral tower would be in clear weather. I once saw from aloft, the top of Port Said Lighthouse when the fog was very thick on deck, and was able to take my ship into Pilotage water.

A Blue Moon.

Whence arose the expression "Not once in a Blue Moon." It is one frequently used by sailors and also by Landsmen, and it appears to me there must be some foundation for it. I can

maintain that such a phenomenon does occur, though on very rare occasions. I have witnessed it twice only during my career, once in the Red Sea, and once in the Southern Indian Ocean. On each occasion the Moon was a day or two after the full and her altitude between 20 and 25 degrees. The time was just before 10 p.m., and then the Moon shone with a distinctly bright blue colour, which lasted for about half an hour. The nights were perfect as regards weather, a few light clouds (cirrus) about, very little wind, and sea calm. The attention of both passengers and others was called to this peculiar appearance.

On the Peculiar Screeching Noise of the Wind during the passage of a Typhoon or Cyclone.

This remarkable occurrence occasionally happens during the passage of these storms. The hideous screeching noise of the wind as though ten thousand demons were doing their utmost to distress and terrorise the unfortunate mariner is one not easily forgotten. This noise is certainly not entirely caused by the wind rushing through the rigging, though on shore we hear a screeching noise when the wind is blowing fresh against the telegraph wires. I have been in the centre of one of these storms on two occasions when the wind has suddenly died away and a calm prevailed; but this noise is heard for a minute or two in the direction the storm is travelling. I remember a Portuguese passenger being very much distressed at this noise. We had been having the wind with hurricane force from the N.E., when the calm centre of the storm passed over us at midnight. Birds, Butterflies and Moths were flying about in great numbers, and the sky became clear over head and the stars visible. This gentleman said he would now go to bed; he had not been in his cabin many minutes, when we could hear the wind coming from the quarter opposite to that in which it had previously been blowing and accompanied by this horrible noise. He came rushing up to me exclaiming "Oh my God what is that noise"! "You will see in a minute or so" I replied. and almost directly a terrific squall struck us from the S. W., and seemed almost to lift the ship out of the water and then bear her down as though to destruction. Can this noise be caused by the torrents of rain being driven through the air? I cannot otherwise account for it. The centre of these storms is very dangerous. The waves run from all directions, and impinging against each other rise up in form of a pyramid and topple over on a ship's deck with force enough to smash in everything. They will try the best found ship.

Luminous Sea.

When this phenomenon is seen at its best it is one of the

most weird and extraordinary sights one can picture and of course is only perceptible at night.

A large number of animals appear to be capable of giving out light which is at any rate often due to the fact that they can secrete some material which is usually spoken of as phosphorescent. Every one has seen the sea shore at night when the crests of the waves are breaking, or the crests of the little waves shining with a bright light; this is due to the presence of enormous numbers of minute animalculæ which can, when in any way disturbed or irritated, emit a phoshorescent fluid. In the Arabian sea I have seen this "White Water" (as sailors call it) in great perfection, when the ocean for miles has resembled a sea of quicksilver, and the darker the night the better the effect. On steaming from the dark ocean into this expanse of "White Water" the effect is extraordinary, the reflection from the water throws a ghastly appearance on every thing, the mast, yards and sails show out with great distinctness and our faces are anything but pleasant to behold. This phenomena sometimes extends for 20 or 30 miles in one direction, but how far in another I cannot say. I have known officers in charge of the watch to stop the engines before coming up to it, imagining the ship was running on to a Coral reef. I have had buckets of water drawn while passing through; on being allowed to stand for a minute or two the water became dark; but plunge the hand in and the whole appeared a blaze of light. On examining the water in daylight a number of minute globular bodies were visible under an ordinary magnifying glass, but I could not distinguish any sign of life in them. Should a school of porpoises or a shark be seen in such water, every part of the head, eyes, back and fins is plainly visible, the shark then is more repulsive in appearance I think than at any other time, and enough to make one shudder at the thought of being overboard.

St. Elmo's Lights.—Comozant or Corposant.

This peculiar and interesting phenomenon is not very frequently seen. It consists of a pale blue light visible at the mast heads or on the yards. These lights seldom appear except during thunder-storms or howling gales of wind and always under most unpleasant circumstances. Being visible only at night they lend to make the phenomenon more mysterious to an ignorant and superstitious seaman. In size they are about as large as the flame of a candle and of a pale blue colour, perhaps one at each mast head and at the yard arms, or on some iron work on the yards. They appear quite suddenly and last for a minute or two, then disappear and then up in some other place, seeming

to flit about, and altogether they have a very uncanny appearance. At close quarters they become invisible, although they may be plainly seen from the deck or at 20 or 30 feet distant. The Straits of Malacca, during the S. W. Monsoon, are often visited with severe thunder-storms, and at such times St. Elmo's fires may occasionally be seen. No damage has ever been known to arise from them, although instances have been reported of them hissing and fizzing like burning damp gunpowder, but this I have never observed, and I expect it can be explained by the rain beating heavily on the yard. These lights seem to be simply a form of Electrical display of the nature of the Brush discharge of an Electrical Machine. The words "Comozant" or "Corposant" are a corruption from Corpus Sanctum.

Water Spouts at Sea.

A water spout in close proximity to a vessel at sea is an ugly looking customer, for in whatever direction you steer the thing seems to be closing down on you. The water seems to be much disturbed and torn up as the spiral column passes. It appears in the distance to be very dense, but on a near approach it becomes more transparent, and seems then to be made up of mist. I have never known any damage to arise from them, and have had one pass over the vessel in the Mediterranean. This happened at night and under heavy rain and a sharp flutter of an awning which happened to be spread at the time, but there was no damage at all. Had sail been set at the time, I dare say some damage would have been caused. I have noticed eleven water-spouts visible at one time in that sea.

Curious effect on a Ship struck by Lightning.

In the year 1859 I was at anchor in Manila Bay, and near us was a wooden British barque. During a violent thunder storm the electric fluid struck the copper spindle at the main-top gallant mast head, ran down the lightning conductor and fused it. The conductor was of the old link type, resembling a surveyor's measuring chain. Some six feet or so of these links fell on deck across the chain cable, and they must have been highly charged with electricity, for the fluid ran along the cable forward, tore off all the iron whelps of the windlass, and went out through the hause pipe into the sea. You may form some idea of the intense heat caused by the sparks given out by these links. They splashed against the skylight windows and melted the glass as readily as a hot poker would melt a bladder of lard; the melted glass ran down for an inch or two like so much molten lead. The decks were charred in many places, but the torrents of rain falling effectually prevented any serious damage. I was on board

the barque the next day and saw the effects. As an illustration of the carelessness exercised in fitting lightning conductors to ships in those days, I may mention that on the vessel I was in the conductor passed through the powder magazine, and it caused no concern or alarm to those high in authority on board. I was a junior officer at the time, but have often since thought how serious matters might have been. Iron ships are very seldom struck, and they are now fitted with conductors of copper rope, which are long enough to reach the water, and on a storm coming on the order is given to put the conductor overboard. The Straits of Malacca are the worst places I know of for thunder-storms, especially on the Sumatra Coast, where the lightning is of an exceptionally dangerous form. In these Straits I have seen the lightning playing about the chain guys of the boats' davits running backwards and forwards, but no harm was done. In iron ships we never sustained damage.

Migration of the Terrapin (Water Tortoise.)

It was in the year 1861 or 1862 that I witnessed a most curious migration of these creatures. I use the term migration with some qualification, as their movement may have been caused by the floods prevailing at the time. It was in the river Hwangpoo, on which the important city of Shanghai is situated, and in the month of June. There appeared for days together myriads of the Terrapin, small and great, floating down with the tide. At the same time there were numbers of dead human bodies also floating down, it being during the reign of terror of the Taiping rebellion. I never heard that the Terrapin would feed on a dead subject, and I don't believe they do. In the South of China the Terrapin is much valued as an article of food; but in Shanghai no one would touch it, not even the French troops, who were not as a rule very particular in this respect. It is a curious fact that I never subsequently during my many voyages to Shanghai ever saw a Terrapin in the river. The distance from Shanghai to where the water becomes brackish is some 30 miles, and there being a low alluvial country the whole of that distance on either side, there was ample space for them to select a new home, which I think must have been the motive of such a movement. I remember at the time the Chinese took but little notice of it as though it were a common occurrence, but for my part I do not think such a migration as I am describing was frequent, or I should certainly have seen something of the Terrapin again in the same waters.

Gulf Stream.

The Gulf Stream is a wonderful phenomenon indeed. It is in reality a river in the ocean, and one of the most marvellous

things of the sea. There are few who have not heard of this warm stream, which has its rise in the Gulf of Mexico, and flows on steadily to the North East until it touches the banks of Newfoundland, when it takes a more easterly direction and reaches the western shores of Great Britain, the Shetland Isles, and goes onward to the Arctic seas. It causes our mild and damp atmosphere. Its effects on the Shetland Isles is very decidedly marked by their being almost free from snow or ice. When this stream starts from the Gulf of Mexico its rate is as much as five miles an hour, which gradually decreases as it flows onwards and widens out; its depth at starting is between 300 and 400 fathoms, and it gets shallower steadily as it gets further to the North East. During its travel it runs up an inclined plane, the cold water from Baffin's Bay and Labrador runs under it on the banks of Newfoundland, for the two streams will not mix. Its inclined plane is estimated to be about three inches to the mile. The Gulf Stream is as well defined at its edge as a river, and the water is higher in the centre than at the sides. In crossing its margin the ship's bow may be in the cold stream with the temperature of the sea as much as 8 to 10 degrees or more lower than that of the water at the stern. My object in touching on the Gulf Stream is to explain that accompanying it is an immense quantity of ocean life in the form of small fish, crustaceans and mollusca, which take refuge in a graceful weed, *Fucus Natans*· In the Sargasso Sea this weed is in immense fields floating on the water, and almost deadens the way of a sailing vessel in passing through it in light winds. I have often hooked up pieces of it when crabs and small fish fell out on deck, some of the former being as much as two inches across the back. Now I believe a small portion of this weed goes along the western edge (although Maury says not), carrying its life with it. Considering the enormous number of living creatures that are spawned so abundantly in the warm water of the Gulf Stream which must cease to live upon meeting the Polar current on the banks of Newfoundland, my contention is that this life does materially assist in the supply of food to the cod-fish on those banks. What is the cause of the Gulf Stream has always puzzled philosophers. Its water is salter than that of the ocean on either side, and is of an indigo blue colour. In the Caribbean Sea and Gulf of Mexico the water is very salt, while that of the Baltic and North Sea are little more than brackish, thus there is a constant stream of strongly impregnated salt water flowing on to mix with the fresher, and preserve the equilibrium. A stream much resembling this, but not so large, is to be found having its source in the North Pacific and flowing on along the coast of the Philippines and Formosa, and the West Coast of Japan. This is called the "Kuro Siwa," or Black

Stream. I have many times crossed it on my voyages from Hong Kong to and from Japan, when the margin was as plainly defined as the banks of the Stour, with the same difference of temperature as is observed in the Gulf Stream. I noticed that the Japan Stream appeared of a much blacker colour than that of the Gulf Stream.

The Equatorial Calm Belt and Cloud Ring.

This region is one of the most unpleasant on our globe, embracing as it does the whole earth between the latitude of three or four degrees on either side of the equator, and no one who has not passed through this region can have any conception of the unpleasant effect it has. All energy seems to be taken out of one, the slightest exertion producing intense perspiration, but without the advantage of any evaporation. In this region rain squalls are very frequent, and you may often see four or five different squalls brewing up at one time. A sharp puff of wind comes lasting a few minutes, with torrents of rain, lasting possibly two or three hours; then it will clear for a time, and then a squall will come from some other direction with torrents of rain. It is a case of constant precipitation, and evaporation seems nearly suspended. Sailing vessels find this region most trying, and every endeavour is made to get across it as quickly as possible. Now why is this Cloud Ring and Calm Space so constant? You are all aware that on each side of the Equator the trade-winds are blowing in the Northern Hemisphere from North-East, and in Southern Hemisphere from South-East, commencing 25 to 30 degrees on either side of the Equator, varying two or three degrees according to the sun's declination. These trade-winds are constant, by blowing and travelling as they do obliquely over a large space of the ocean they become heavily laden with moisture, and having no room to expand but in an upward direction, the air ascends and becomes cooler, a portion of its vapour being then condensed comes down in the shape of rain: therefore it is that under these calms we have a region of constant precipitation, after some of these squalls the surface of the sea is quite fresh. A peculiarity of this cloud ring is the inky blackness of the clouds. In the Straits of Malacca this is particularly so. There the distant land, with its wonderful tropical vegetation, shews up of a jet black such as I have never seen in any other part of the world. Our old Commodore, in describing one of these rain squalls which he had passed through on the previous night, said he thought the bottom of a cloud had tumbled out. In this Equatorial Calm space it is a noted fact that the barometer and thermometer both stand lower than on either side of it. All through the Tropics there is a regular barometric tide, the rise and fall amounting to one tenth of an

inch, the maximum being about 10 a.m. and 10 p.m., and the minimum about 4 a.m. and 4 p.m. This tide decreases the further North or South you proceed, until it ceases altogether. One noticeable thing about the trade regions is that the upper clouds are all travelling in a contrary direction to the trade-wind itself. The islands about the Straits of Malacca are sometimes visible directly their top shows above the horizon. I was coming from China to Bombay one voyage, and had among our passengers a gentleman who was musketry instructor to the Buffs' regiment at Hong Kong. I may say this officer was recently stationed here, and I had an opportunity of talking on what I am about to relate. We had sighted land ahead at the entrance of the Straits of Singapore, and I remarked to him, "Now you are sure, or ought to be, a good judge of distance, how many miles do you say that land is off? I will give you a margin of 25,000 yards." "Absurd," he replied. "Well, how far do you say?" "Thirty-five miles" was his reply, and it was 90 nautical miles. He had not thought of asking the height of the island, which was some 4,000 feet, and the top then showed out as black as ink.

Floating Pumice.

For a considerable time after the eruption of Krakatoa in 1883, (when that island, although 2,000 feet in height, was literally blown to atoms, and the town of Anjer destroyed), the sea, for a space of 300 or 400 miles in a North and South direction, was covered with a large quantity of pumice stone. I was much surprised at the colour of this stone. It was not unlike that of a sponge, and in size the pieces were from two to three feet in length down to mere dust. I am not prepared to say this ever was the result of the Krakatoa eruption, as it may have been caused by a submarine one near the locality. How far this pumice extended in an East and West direction, I am unable to say. If it proceeded from Krakatoa it had been carried 750 nautical miles to where I observed it on my voyages to Australia. We passed through it, and it was at least a couple of years before it all disappeared.

Brilliant Colours of the Dolphin whilst Dying.

The Porpoise is often described as the Dolphin, but it is not the Porpoise to which I am alluding, but the *Dourado Coryphæna* (the Dolphin of the Poets). This fish in its dying struggles is constantly changing colour, often first a pale blue, then yellow, pink, and a dark blue, but with no particular order. These changes go on until life is out of the fish, and if two are caught

at the same time and placed side by side, the change of colour in each fish will probably be quite different, for there appears to be no regular order in this marking. To what this peculiar colouring is due I am unable to explain. The fish in its element is very pretty. They may be as much as three feet in length, and are what I may term a deep fish. Their colour, while in the sea, is of a blueish black on the back, but the sides, belly, fins, and tail are a brilliant yellow. It is very amusing to watch one chasing a large flying fish of eight or nine inches in length. The Dolphin is capable of swimming about as fast as the flying fish can go on its flight, and is ready to seize its prey immediately it drops, often after a chase of 200 yards. The flying fish evidently knows its enemy is beneath, for with just a touch of the water with the tail it is off again in the air, very likely at right angles. This movement is sometimes successful, but more often I fancy not. Although the Dolphin is such a handsome fish it is one of the very poorest eating. After death when viewed in the dark they always give out a phosphorescent appearance, which lasts for some hours, and should the moon be shining on them they are considered by sailors as poisonous, as are all fish exposed to the rays of the moon. There may be some truth in this.

Flight of Locusts in Red Sea.

There is every few years an enormous flight of Locusts crossing the Red Sea. The ones I observed were apparently coming from the Arabian side attempting to reach the Egyptain Coast. Myriads of them fall from exhaustion into the water, and I have seen the Sea for miles one seething mass of living and dead Locusts until the water was actually red with them. Our native crews catch them by hundreds and grill them over the charcoal fires, and eat them with great relish, and really they are not at all bad, and with a scarcity of other food I should think would be very acceptable. I have wondered in my innocent mind if it is possible that the Locust we read of in Scripture as used for food may have been this insect.

In the Red Sea in Autumn, the surface is covered with vast quantities of a floating red substance, which under the microscope is found to be a very delicate kind of sea weed. I have frequently examined it and noticed it resembled semi transparent pea or bean pods, with the seeds separate and each pod containing some six or eight seeds. The red appearance of this small weed is I believe really the origin of the name given to that sea although the Locusts cause the surface for many miles to assume a red colour.

Flight of Sea Birds.

There is a motive power possessed by some sea birds which I have never heard fully explained and it is to me a mystery. Take for instance the Albatross the largest of the sea birds. They are of considerable size weighing some 20 lbs. or more, and measuring 15 or 16 feet between the tips of the wings. These birds seldom settle on the water unless during a calm or when they alight for food. They appear to be capable of propelling themselves in any direction either with the wind, (which is simple enough) or against it and without the slightest perceptible movement of the wings, and they can go even against a brisk gale without any apparent effort. They have a slight cant to one side or the other according to the direction in which they wish to go, but I have never been able to discern the slightest movement of the wings or tail, I have watched them frequently through my binoculars when only a few feet distant and under most favourable times of observation, but I have failed to detect any propelling power to force them against the wind. In calm weather they may give an occasional flap or two of the wings and go on again as happy as ever. I have never heard anything advanced as to how their propelling power is obtained. The bones are all pneumatic and large, and cavities are situtated between the muscles and in the body. I may say that every portion of the bird floats in water, bones and all. They have a noble and handsome appearance both when on the wing and on the water. A peculiar feature of these birds as well as of many sea fowl is that when first caught on board ship they vomit a quantity of clear oil of a very fishy smell. I have often wondered is this oil carried by the bird as a store of food when that is scarce; there is an impression that the Albatross will attack a person in the water, I believe they are far too nervous to do so, but will alight close to a man who may have fallen overboard, but at no time have I seen them attempt to attack him.

Do Fish Sleep ?

I certainly believe they do, especially the Whale Species, for I have frequently seen them like a log in the water when they would not move unless disturbed. I once ran down a whale between Ceylon and Aden, we were at dinner about 6.30 p.m. when I heard the engine room telegraph bell ring and the engines suddenly stop ; there was a feeling immediately afterwards as if the ship had struck something. It was a case of all hands hurrying on deck when the officer of the watch pointed out a huge whale a short distance off and

the sea around it dyed with blood. The officer told me that neither himself nor the man on the look out had seen it until the ship was on the point of striking it as the creature was lying just below the surface of the water. The sea was quite calm at the time. I should have thought the noise of the propeller or ship rushing through the water would have alarmed it but it was not so, leading me to believe the creature was either asleep, blind, or stone deaf, but I believe asleep. Again I have known a shark to be thrown up on the after sponson of the S.S. "Pottinger" in the Red Sea. It measured 8 to 9 feet in length, one would think the noise of the paddle floats would have warned any fish of danger, but both the whale and shark take things very easily at times and have a lazy fit as though dozing, but are pretty lively when on the look out for food.

Voracity and Vitality of the Shark.

The Shark is the most voracious fish I should think that inhabits the sea, nothing seems to come amiss to him, rope yarns, bits of crockery, bones, or even old boots, to say nothing of human beings. To illustrate the vitality of the shark which came under my own observation, one had been swimming round the ship for sometime, (I was in a sailing ship, becalmed) when at last we had an opportunity of harpooning it. We had nearly got it on board, when the harpoon drew and overboard the fish went. Same time some of its entrails were drawn through the back, but after a short time it returned with a portion of its inside trailing along. We baited a hook with a piece of salt pork and actually caught the brute, which measured some 8 or 9 feet in length. It must have been very hungry for there was no food of any description in the stomach.

The heart of a Shark will pulsate for an hour after being cut out, even if cut into several pieces. The Shark at sea is always accompanied by three or four pilot fish, the "Naucrates ductor." This little fish resembles a Perch, but is otherwise related to the Mackerel. Sailors believe they warn the Shark of danger. I have seen them rush ahead of his majesty as though to see if any object in the water is fit for food. They are a pretty fish, but I have never succeeded in capturing one.

The Shark has a very ugly black parasite which clings most closely to it, the Sucking fish "Remora." This parasite measures as much as 5 inches in length a perfect fish in appearance, the broad head being nearly half its length, and it has on the upper part of the head a round plate by which it is able to adhere to the skin of the Shark. I don't see how the Shark is to get rid of

what must be a torment. I have noticed 6 or 7 of these parasites on one Shark.

The Shark if a young one is not at all bad eating, and it resembles the Skate in taste. I know in my young days at sea it was a treat to catch one, but we were glad of anything after so much salt meat.

Speed of Fish.

The swiftest denizens of the deep I believe will be found to be the Porpoise of sailors "Delphinus delphis." They never seem to tire, but play about under the bows of a steamer going 16 or 17 knots an hour, turn and go astern, and then come racing past her as though she were at anchor, and this not once or twice but for half an hour or more. I estimate their speed at these times to be nearly at the rate of 30 miles an hour and besides they have to rise to the surface to breathe every minute or so. It must be an easy matter for them to run down any fish they may be after. The Porpoise has a very keen idea of danger; if one be wounded they all clear off at once. As they are warm blooded creatures they bleed excessively when wounded. Sailors before fresh tinned provisions were used were very glad to get one, the flesh is very dark and tastes not unlike a very tough steak with no flavour of fish whatever. The Kidneys were the favourite and they resemble two large bunches of grapes.

Flight of the Dragon Fly.

The Dragon Fly with its immense wings has marvellous powers of sustaining itself in all weathers without resting. I have seen them in dozens in the middle of the China Sea, and 150 miles from the nearest land when the wind was blowing with the force of half a gale. They were flying about and against the wind with the greatest ease, the wind having but little effect on their power of flight. They were just as active then as in a calm and never attempted to alight, but seemed to be hunting insects belonging as it were to the ship of which there are plenty even in mid ocean. They are called Typhoon flies in China and their appearance at sea is supposed to be a precursor of one of those terrible storms, but I never took much notice of them for as a rule no storm was near. How or where they rested at night I could never learn. They may have rested on the rigging but I certainly never saw one there. They must be the swiftest of all insects.

Portuguese Man of War.

(P. Pelagicus.)

This beautiful bladder-like form is a true denizen of the tropical seas, especially in the Atlantic within the tropics, where

it is found in prodigious numbers. It is though occasionally borne by winds and currents into the Western basin of the Mediterranean Sea and on the Coast of Portugual and Spain. Specimens have been even found as far North as the Isle of Wight. This animal reaches 8 to 9 inches in length and is chiefly remarkable for its brilliant irridescent tints of orange, purple, and blue colours which it displays as it sails along on the surface of the sea. It uses its semi-circular membrane or crest as a sail which it lowers or erects at pleasure, and with a moderate breeze it will sail along at the rate of a mile and a half an hour, It is furnished with tentacles capable of extension from a few inches to several feet, and it possesses, in an unusual degree, the stinging properties of its species. At every few inches of this tentacle is to be seen a dark blue globular body about the size of a No. 1 shot, which appears to be the stinging organ.

I once saw a soldier drummer boy driven nearly mad by one of these animals, which a comrade had caught and placed round the boy's neck. The military surgeon on board had never seen a case of the kind before, and said the stings were as bad as those of a dozen wasps. The poor boy was delirious for sometime. It is interesting watching the animals, when they meet the waves from the bow of a ship, the membrane is lowered instantly and after the wash is over, up it goes again and they go sailing along none the worse for the disturbance. Sailors used to call them the Nautilus but they are totally different having no shell.

VI.

COAST EROSION REPORT.

BY

G. DOWKER.

Since my last report on the Coast Erosion, on the shore between Deal and Ramsgate, and thence to Herne Bay, we have had a remarkable storm and high tide, which happened between the 27th and 29th of November, 1897.

The high tide was then accompanied by a North-East gale, which seems to have followed the tidal wave from the North sea, causing it to rise to an unusual height. At Ramsgate harbour the height of the tide could not be exactly measured, as it exceeded the maximum of the tidal guage at the harbour's mouth, which registers a height of 23 feet 10 inches. The average height of high water here is 19 feet, so that in this gale the tide was raised 4 feet 10 inches above the normal level. On the 26th instant the tide reached a height of 16 feet 10 inches only. On the 27th, two hours before high tide, the sea was washing over the footpath in front of the Colonnade and reaching the road in Lower Harbour Street, while two hours later the waves were so high as to break over the entire Colonnade, destroying that structure as may be seen in the photograph No. 1. The waves tore down part of the wall of the London, Chatham, and Dover Railway station, and broke down the iron fence in front of the Colonnade, twisting and breaking the iron standards as if they had been but lead pipes. At the same time the waves were breaking over the pier on the East, and carried away a large piece of the stone parapet as seen in photograph 2. The cliffs between Ramsgate and Broadstairs suffered severely from the chalk talus of the cliffs being carried away. At Broadstairs the Jetty was wrecked, the whole structure being under water and the foundation and large blocks of concrete being carried away. Between Ramsgate and Sandwich, near the "Sportsman," the sea flowed over the turnpike road into the marshes beyond, and a large quantity of the grass-covered shore was carried clean away. At Stonar the tide overflowed, filling all the lower parts of the Stonar beach, converting it into a lake. In Sandwich also the water overflowed and flooded parts and the marshes in front. It is worthy of note, however, that an old bank which had been raised two feet since a former flood, was there sufficient to stem the tide. At Sandwich bridge the tide rose to 14 feet, while the average high tides are from eight to ten feet. At Margate the Marine

Palace was entirely destroyed and the Jetty much damaged, the waves entirely covering it, and all the fore-shore from Margate to Birchington was much damaged by the washing away of the supports to the base of the cliffs.

Whitstable and Herne Bay.

The whole of the promenade was placed under water at the high tide, and many thousand pounds worth of damage done, while the low-lying parts of Herne Bay were flooded, and at Whitstable there were ten feet of water in the main street, and several houses were washed away, including the old "Neptune" public house and the boat-building houses on the shore.

Deal.

At Deal the effect of the tide was most disastrous to the fore-shore. The town being chiefly built upon the beach, but little above high water mark at spring tide, the waves threatened the whole front of the town, and destroyed several boat houses on the beach and flooded a large portion of the lower-lying portions of the town. At Sandown there is a large natural embankment of beach stretching along the shore from Sandown Castle; this has been accumulating for several years, and the beach, thrown up by the sea, forms a protection as regular as a railway embankment, and has completely shut out the sea from the low-lying land behind, but the waves overflowed this and formed a large lake of sea water behind. Great efforts had been made to protect the North part of the town by artificial groins and works along the fore-shore, which received much damage by the gale.

From the foregoing report it will be seen that the chief damage done to the shore line has been more the result of the excessive high tides than anything else. But we shall find that the total effects have been a loss to the shore and a gain to the sea. Nor do we find that there has been any counter-balancing gain by shore deposits all along the coast. At Pegwell Bay, at Deal and Walmer, at Margate, and Whitstable, the same is the case.

The map will show generally where the damage has been greatest.

The photographs and map which have been placed in the Society's Album, and for some of which I am indebted to Mr. S. Manser, of Deal, will give a better idea of the flood near its height. The storm seems to have scoured out the fore-shore below low water mark, as well as washing away the beach at high-water mark. And a report made to the Town Council showed that the low water mark was nearer the wall than it had been when

reported upon by the Surveyor, and the level of the beach only 2 feet 6 inches above the foundations of the sea wall.

At Margate a series of views were taken, showing the effects of the storm on the Pier and shore. These have been printed and sold on the book-stalls at the railway stations.

BOTANICAL REPORT.

BY

G. DOWKER.

In respect to the Flora of the district I have to report mostly on the losses rather than gains.

Lepidium latifolium seems to have entirely disappeared from its old habitat between Sandwich and Deal, the only place where I have found this plant in East Kent. *Epipactis palustris*, which I have known in certain localities in great abundance for many years past, I searched for in vain last year, and I think it must have been transplanted wholesale or taken root and all by the rare plant collectors. These gentlemen are becoming an intolerable nuisance, for rather than work for a living they go with a spade or trowel to collect ferns or other plants, and take them round the towns to sell, while others as effectually destroy the plants by gathering the flowers. The *Orchidaceæ* especially suffer from these depredators. The sandhills between Deal and Sandwich by the sea-shore have long been noted for the abundance of the sea holly, *Eryngium maritimum;* it is now systematically cut off close to the ground when in full bloom by these robbers to such an extent that the plant is getting scarce, although nothing like exterminated. In the neighbourhood of towns the *Caltha palustris* is disappearing from our marshes from the same cause. *Typha latifolia*, the large bull-rush as it is called here, is being exterminated, and *Typha angustifolia* is carried away by the cart load to sell in the towns. *Falcaria vulgaris*, which I discovered some forty years ago in Kent, is still to be found in the same field where I met with it, but it has not extended any further. The last season produced some very fine spikes of the orchids, among which I have to record one from the neighbourhood of Wye, where it has not been fonnd for many years past, and in the Dartford neighbourhood it still lingers. *Astragalus hypoglottis*, by no means a common plant in East Kent, is still met with in its old localities, and the same may be said of *Helleborus viridis*. *Sambucus Ebulus*, dwarf elder, I have not met with for some years past. *Alyssum incanum* has been found recently in the arable fields in the neighbourhood of Chatham.

VII.

COAST EROSION, 1897.

BY

CAPTAIN McDAKIN.

The shingle is still leaving the coast from Dover eastward to Walmer, a distance of seven miles (the extent of this report to the east).

No remarkable falls of the cliffs have taken place on this side of Dover. In the early part of the year there was a small fall about a quarter of a mile west of the South Foreland light. The remarkable fissures opening on the top of the cliff, mentioned in previous report, between South Foreland and "Signal Ho," in map, continue to increase and point to a fall of considerable quantity in a short time.

To the West of Dover, about the end of February last, three falls took place from Shakespeare Cliff, see map and accompanying photographs, quite altering the face of the cliff, and is supposed to be the most considerable since 1810. In the bromide permanent photograph (A) the Coast Guard station is indicated by the flagstaff and hut; in (B) they have disappeared. They were removed. the condition of the cliff being considered dangerous, and they have not up to this time (3 years) 1897, been replaced.

On the 5th February, 1897, a fall of about 70 tons took place at the back of 163 Snargate Street, Dover (Wood & Co.'s), and a fall from the Castle cliff at the rear of the Guilford Battery.

The falls from the West cliff between Shakespeare cliff and Folkestone were foretold in the previous reports, through the translation of the protecting shingle and destruction of the undercliff. A considerable factor has also been the erosion of the sea and slipping forward of the undercliff, caused by the numerous springs sapping the base of the cliff. This is very noticeable at the West end of Abbotscliff. There is also a downward displacement of the cliff, at the top, near Wine Houses, in map where some crosses + + + show a downward movement $+ {}_{+} +$ of the centre cross.

There is a small slip of the ferruginous beds capping the cliff, about 450 feet above sea level, a quarter of a mile west of

Lydden Spout Coast Guard Station. The South-Eastern Railway Company are building a sea-wall, draining the base of the cliff, and erecting groins to intercept the sand and shingle which travel eastward, and are not replaced in quantity from the west, as they were before the seaward extension of the Folkestone breakwater. There was but little frost last winter, but the unusual rainfall of the past autumn and winter will account for that portion of the falls where the cliffs are not attacked by the sea. I have experimentally found many of the beds of chalk, when air dried, take up from 18·4 to 22·75 per cent. of moisture.

VIII.

COAST EROSION, 1897–98.

BY

CAPTAIN McDAKIN.

Since the great fall from Shakespeare's Cliff (reported last year) to the West of Dover, and a small fall near the South Foreland Coast Guard Station to the East of Dover, which took place in the early part of the winter of 1897—98, there has been no noticeable change. These cliffs are so lofty (about 350 feet) and in many places perfectly perpendicular, that although the fallen mass may weigh many thousands of tons, the encroachment on the land surface does not amount to many feet.

The South-Eastern Railway Company, for the protection of their line, have erected a concrete sea-wall, extending from about two miles from Lydden Spout Coast Guard Station, east of the Abbott's Cliff tunnel to about a mile from the West end of the same tunnel. This work is supplemented by about twenty groins running at right angles to the wall. These groins are built of railway bars and three-inch deals, all bolted most securely together. Several of these were destroyed by the winter gales, and iron railway bars broken as if they had been laths.

The object of these groins is to arrest the shingle travelling from the Westward, that it may form a natural apron to the wall, and prevent the foundations from being scoured out by the falling action of the waves. It will be seen from the diagram that this is a very difficult engineering work, as the springs, which are abundant, flow out over the gault clay and are always

sapping the base of the cliffs, together with the sea wall. There is now comparatively very little shingle on the coast from Folkestone to the East of St. Margaret's, except in the angle formed by the Admiralty pier with the coast at Dover. That is of course on the West side.

The great gale on the 24th and 25th March, produced but little effect on this part of the coast, the wind having been off-shore, but, as before observed, an off-shore wind piles the shingle on the beach, an on-shore wind carrying the shingle into deep water.

NOTES.

In August, 1898, a fine specimen of a whale was cast ashore at St. Nicholas Bay, near white post hole, in the Isle of Thanet. It was reported by Mr. G. R. Burden, of St. Nicholas-at-Wade, to be a male specimen of the Greenland whale, 42½ feet in length, and measured 13 feet from the tip of his nose to his forehead, and about 30 feet in circumference, and 8 feet across the tail. It was in a very advanced state of decomposition, and gave no end of trouble to those that tried to remove it, it having been purchased by a Mr. Osmond. That gentleman was required by the Sanitary Authorities to remove it, but this being no easy matter it was attempted to set fire to it on the spot, but this also failed. The District Council were in a fix what to do with this "white elephant"; it was even suggested to blow up the animal with gunpowder or dynamite. Eventually, however, it was cut up, and the skeleton, I believe, taken to London for a museum. I think there is some question about the species of whale it belonged to.—G.D.

At Ramsgate a mammoth tooth was met with in making some excavations near the gas works, under some rather exceptional circumstances, viz., that it was buried so deep in what appeared to be pure undisturbed chalk as to lead some to suppose it belonged to that formation, and the specimen was brought to my observation as to this question. It appears that it had been washed down a deep valley that runs, or empties itself, into the sea by the harbour from the higher grounds beyond the water works, and that it was covered with pure

chalk mud, showing that it was deposited at an early date before the large quantity of gravel and clay drift had been washed down into the valley.—G. D.

Sea temperatures at Dover for the winter 1897–98, represented an average for December, 1897, January and February, of 46·33. The lowest on 20 February, 1898, of 43. For the winter of 98–99, December, January and February, represented an average of 48·33. The lowest on the 2nd of February of 45. The highest sea temperatures for three years taken in the month of August are remarkably the same: August, 1896—66; August, 1897—65; August, 1898—66.

Fogs generally occur when sea and air temperatures are about the same, possibly by the warm air current being chilled to temperature of sea.

During the progress of the Harbour extension works, a fan of river gravels has been encountered, covering a large portion of the bottom of the Bay, in some places 18 feet in thickness and as hard set as a turnpike road. In these gravels two Mammoth's teeth have been found, one in January, 1896, and another in December, 1898.—S. G. McDakin.